

# MOFFAT

COLLECTION SYSTEM PROJECT  
FINAL ENVIRONMENTAL IMPACT STATEMENT

## Table of Contents



---

## Table of Contents

# TABLE OF CONTENTS

---

## **Volume 1 of 10**

Glossary.....	Glossary 1
Acronyms .....	Acronyms 1
Executive Summary .....	ES-1
ES.1 Introduction.....	ES-1
ES.2 Cooperating Agencies (EIS Chapter 6) .....	ES-2
ES.3 Public and Agency Participation (EIS Chapter 6) .....	ES-3
ES.4 Purpose and Need (EIS Chapter 1) .....	ES-3
ES.4.1 Purpose and Need Statement .....	ES-6
ES.5 Alternatives Analysis (EIS Chapter 2).....	ES-7
ES.5.1 Screening.....	ES-7
ES.5.2 Alternatives .....	ES-8
ES.6 Total Environmental Effects (EIS Chapter 4).....	ES-10
ES.6.1 Reasonably Foreseeable Future Actions, Water- and Land-based Projects and Geographic Boundaries .....	ES-11
ES.6.2 Surface Water.....	ES-13
ES.6.3 Water Quality.....	ES-18
ES.6.4 Channel Morphology .....	ES-20
ES.6.5 Groundwater .....	ES-23
ES.6.6 Vegetation .....	ES-24
ES.6.7 Riparian and Wetland Areas .....	ES-24
ES.6.8 Wildlife .....	ES-24
ES.6.9 Special Status Species.....	ES-24
ES.6.10 Aquatic Biological Resources.....	ES-25
ES.6.11 Air Quality .....	ES-26
ES.6.12 Recreation .....	ES-26
ES.6.13 Land Use .....	ES-26
ES.6.14 Visual Resources.....	ES-27
ES.6.15 Socioeconomics .....	ES-27
ES.6.16 Other Resources .....	ES-28
ES.7 Moffat Project Effects (EIS Chapter 5) .....	ES-28
ES.7.1 Environmental Pool .....	ES-28
ES.7.2 Surface Water.....	ES-29
ES.7.3 Water Quality.....	ES-38
ES.7.4 Channel Morphology .....	ES-40
ES.7.5 Groundwater .....	ES-43
ES.7.6 Geology .....	ES-44
ES.7.7 Soils.....	ES-45
ES.7.8 Vegetation .....	ES-46
ES.7.9 Riparian and Wetland Areas .....	ES-47
ES.7.10 Wildlife .....	ES-50
ES.7.11 Special Status Species.....	ES-53
ES.7.12 Aquatic Biological Resources.....	ES-55

# TABLE OF CONTENTS

---

ES.7.13	Transportation.....	ES-56
ES.7.14	Air Quality.....	ES-57
ES.7.15	Noise.....	ES-57
ES.7.16	Recreation.....	ES-58
ES.7.17	Land Use.....	ES-61
ES.7.18	Visual Resources .....	ES-62
ES.7.19	Cultural/Historical/Paleontological Resources.....	ES-65
ES.7.20	Socioeconomics .....	ES-67
ES.7.21	Hazardous Materials .....	ES-71
ES.8	Mitigation .....	ES-71
ES.8.1	Explanation of Appendix M in the Final EIS .....	ES-71
ES.8.2	Concurrent Planning Documents Relevant to Mitigation in the Final EIS .....	ES-72
<b>Chapter 1 – Purpose and Need .....</b>		<b>1-1</b>
1.0	Introduction .....	1-1
1.1	Project Purpose and Need Statement.....	1-1
1.2	Denver Water’s Preferred Alternative.....	1-4
1.3	Denver Water’s Existing System .....	1-5
1.3.1	Raw Water Collection System.....	1-5
1.3.1.1	North System Overview .....	1-6
1.3.1.2	South System Overview .....	1-6
1.3.1.3	Replacement Facilities.....	1-7
1.3.1.4	Non-Potable Recycling Facility .....	1-10
1.3.1.5	Hydropower Generation .....	1-10
1.3.1.6	Implications of Denver Water’s Raw Water Collection System and Operations to Project Purpose and Need .....	1-11
1.3.2	Treated Water System .....	1-12
1.3.3	Denver Water Customers .....	1-12
1.4	Basis for Purpose and Need.....	1-14
1.4.1	Existing and Future Demand .....	1-14
1.4.1.1	Existing Use and Demand Forecast.....	1-16
1.4.1.2	Conservation.....	1-18
1.4.1.3	Natural Replacement .....	1-19
1.4.1.4	Intergovernmental Agreement with Arvada .....	1-19
1.4.1.5	Strategic Water Reserve .....	1-19
1.4.1.6	Demand Summary .....	1-20
1.4.2	Yield of Denver Water’s System.....	1-21
1.4.2.1	PACSM Modeling Overview .....	1-22
1.4.3	Denver Water’s Near-Term Strategy (Present to 2032) .....	1-23
1.4.3.1	Conservation.....	1-23
1.4.3.2	Non-Potable Recycling.....	1-23
1.4.3.3	System Refinements .....	1-23

# TABLE OF CONTENTS

---

1.4.4	1.4.3.4 Cooperative Projects .....	1-24
	1.4.3.5 Summary of Near-Term Strategy.....	1-25
	1.4.4 Timeliness and Location of New Yield .....	1-25
	1.4.4.1 Raw Water Availability to the Moffat Treatment Plant (System Reliability) .....	1-26
	1.4.4.2 System Vulnerability .....	1-27
	1.4.4.3 Operational Flexibility .....	1-27
	1.4.4.4 Summary .....	1-28
1.5	Required Permits and Approvals .....	1-28
1.6	Agency and Public Scoping Issues .....	1-31
<b>Chapter 2 – Proposed Action and Alternatives .....</b>		<b>2-1</b>
2.0	Introduction.....	2-1
2.1	Preliminary Alternatives Screening Process .....	2-3
2.1.1	Screen 1a.....	2-4
	2.1.1.1 Long List of Water Supply Sources and Components .....	2-8
2.1.2	Screen 1b.....	2-10
2.1.3	Screen 1c.....	2-15
2.1.4	Screen 2.....	2-19
	2.1.5 Refinement of EIS Alternatives .....	2-22
2.2	Overview of Alternatives.....	2-25
2.3	Proposed Action.....	2-35
2.3.1	Introduction/Abstract .....	2-35
2.3.2	Project Components .....	2-38
	2.3.2.1 Gross Reservoir.....	2-38
2.3.3	Proposed Changes to Denver Water’s System Operations .....	2-54
2.4	Alternative 1c – Gross Reservoir Expansion (40,700 AF)/New Leyden Gulch Reservoir (31,300 AF) .....	2-59
2.4.1	Introduction/Abstract .....	2-59
2.4.2	Project Components .....	2-62
	2.4.2.1 Gross Reservoir.....	2-62
	2.4.2.2 Proposed Leyden Gulch Reservoir .....	2-64
2.4.3	Proposed Changes to Denver Water’s System Operations .....	2-72
2.5	Alternative 8a – Gross Reservoir Expansion (52,000 AF)/Reusable Return Flows/Gravel Pit Storage (5,000 AF).....	2-73
2.5.1	Introduction/Abstract .....	2-73
2.5.2	Project Components .....	2-76
	2.5.2.1 Gross Reservoir.....	2-76
	2.5.2.2 Proposed Gravel Pit Storage Facilities .....	2-78
2.5.3	Proposed Changes to Denver Water’s System Operations .....	2-87

# TABLE OF CONTENTS

---

2.6	Alternative 10a – Gross Reservoir Expansion (52,000 AF)/ Reusable Return Flows/Denver Basin Aquifer Storage (20,000 AF) .....	2-89
2.6.1	Introduction/Abstract.....	2-89
2.6.2	Project Components.....	2-92
2.6.2.1	Gross Reservoir .....	2-92
2.6.2.2	Proposed Aquifer Storage and Recovery System .....	2-93
2.6.3	Proposed Changes to Denver Water’s System Operations.....	2-96
2.7	Alternative 13a – Gross Reservoir Expansion (60,000 AF)/ Transfer of Agricultural Water Rights/Gravel Pit Storage (3,625 AF) .....	2-99
2.7.1	Introduction/Abstract.....	2-99
2.7.2	Project Components.....	2-103
2.7.2.1	Gross Reservoir .....	2-103
2.7.2.2	Proposed Gravel Pit Storage Facilities .....	2-104
2.7.3	Proposed Changes to Denver Water’s System Operations.....	2-109
2.8	Construction Activities for All Action Alternatives.....	2-111
2.8.1	Schedule and Sequencing .....	2-111
2.8.2	Temporary Sediment and Erosion Control.....	2-114
2.8.3	Pipeline Construction Methods .....	2-114
2.8.4	Construction Equipment.....	2-115
2.8.5	Construction Traffic .....	2-115
2.8.6	Construction Manpower Estimate .....	2-117
2.8.7	Post-Construction Activities for All Action Alternatives .....	2-118
2.9	Estimated Cost of Alternatives .....	2-119
2.9.1	Action Alternatives.....	2-119
2.9.2	No Action Alternative .....	2-120
2.10	No Action Alternative .....	2-121
2.10.1	Introduction/Abstract.....	2-121
2.10.2	Project Components.....	2-122
2.10.2.1	Strategic Water Reserve Strategy .....	2-123
2.10.2.2	Mandatory Restrictions Strategy .....	2-125
2.10.3	Definition of No Action Alternative.....	2-129
2.10.4	Implications of the No Action Alternative .....	2-130
2.10.4.1	Susceptibility to Unforeseen Challenges to the Water Supply System .....	2-130
2.10.4.2	Raw Water Shortages .....	2-130
2.10.4.3	Unmet Treated Water Demands .....	2-131
2.10.4.4	Increased Treatment Plant Vulnerability .....	2-131
2.10.4.5	Drawdown of Gross Reservoir .....	2-132
2.11	Comparison of Alternatives.....	2-133
2.11.1	Comparison of Alternative Elements .....	2-133
2.11.2	Comparison of Impacts.....	2-133

---

# TABLE OF CONTENTS

---

## Volume 2 of 10

Chapter 3 – Affected Environment .....	3-1
3.0    Introduction.....	3-1
3.1    Surface Water .....	3-21
3.1.0    Overview.....	3-21
3.1.1    Reservoirs .....	3-22
3.1.1.1    Gross Reservoir.....	3-22
3.1.1.2    Leyden Gulch Reservoir Site .....	3-22
3.1.2    Conveyance Systems .....	3-23
3.1.2.1    Conduit M .....	3-23
3.1.2.2    Conduit O.....	3-24
3.1.3    South Platte River Facilities.....	3-25
3.1.4    Denver Basin Aquifer Facilities.....	3-25
3.1.5    River Segments .....	3-26
3.1.5.1    Fraser River.....	3-27
3.1.5.2    Williams Fork River .....	3-38
3.1.5.3    Colorado River.....	3-43
3.1.5.4    Blue River .....	3-47
3.1.5.5    South Boulder Creek.....	3-51
3.1.5.6    North Fork South Platte River .....	3-54
3.1.5.7    South Platte River .....	3-55
3.2    Water Quality.....	3-61
3.2.0    Overview.....	3-61
3.2.1    Reservoirs .....	3-66
3.2.1.1    Gross Reservoir.....	3-66
3.2.1.2    Leyden Gulch Reservoir Site .....	3-67
3.2.1.3    Williams Fork Reservoir.....	3-68
3.2.1.4    Three Lakes (Granby Reservoir, Shadow Mountain Reservoir, and Grand Lake) .....	3-68
3.2.1.5    Dillion Reservoir.....	3-70
3.2.2    Conveyance Systems .....	3-71
3.2.3    South Platte River Facilities.....	3-71
3.2.4    Denver Basin Aquifer Facilities.....	3-71
3.2.5    River Segments .....	3-72
3.2.5.1    Fraser River.....	3-72
3.2.5.2    Williams Fork River .....	3-89
3.2.5.3    Colorado River.....	3-97
3.2.5.4    Muddy Creek .....	3-105
3.2.5.5    Blue River .....	3-108
3.2.5.6    South Boulder Creek .....	3-114
3.2.5.7    North Fork South Platte River .....	3-117
3.2.5.8    South Platte River .....	3-121

# TABLE OF CONTENTS

---

3.3	Channel Morphology .....	3-135
3.3.0	Overview .....	3-135
3.3.1	Reservoirs .....	3-135
3.3.1.1	Gross Reservoir .....	3-135
3.3.1.2	Leyden Gulch Reservoir Site.....	3-136
3.3.2	Conveyance Systems .....	3-136
3.3.3	South Platte River Facilities .....	3-136
3.3.4	Denver Basin Aquifer Facilities .....	3-136
3.3.5	River Segments.....	3-136
3.3.5.1	Fraser River Basin .....	3-141
3.3.5.2	Williams Fork River Basin.....	3-147
3.3.5.3	Colorado River Basin .....	3-149
3.3.5.4	Blue River Basin.....	3-151
3.3.5.5	South Boulder Creek Basin .....	3-153
3.3.5.6	North Fork South Platte River Basin.....	3-155
3.3.5.7	South Platte River Basin.....	3-157
3.3.6	Reconnaissance River Segments .....	3-157
3.3.6.1	Fraser River Basin Reconnaissance Sites .....	3-160
3.3.6.2	Williams Fork River Basin Reconnaissance Sites .....	3-161
3.3.6.3	Colorado River Basin Reconnaissance Sites .....	3-164
3.3.6.4	Blue River Basin Reconnaissance Sites .....	3-164
3.3.6.5	South Boulder Creek Basin Reconnaissance Sites .....	3-165
3.3.6.6	North Fork South Platte River Basin Reconnaissance Sites.....	3-166
3.3.7	Sites of Special Interest .....	3-167
3.3.7.1	Fraser River Downstream of Diversions .....	3-167
3.3.7.2	Fraser River Upstream of Diversion.....	3-168
3.3.7.3	South Platte River Downstream of Hayman Fire.....	3-168
3.4	Groundwater .....	3-169
3.4.0	Overview .....	3-169
3.4.1	Reservoirs .....	3-169
3.4.1.1	Gross Reservoir .....	3-169
3.4.1.2	Leyden Gulch Reservoir Site.....	3-170
3.4.2	Conveyance Systems .....	3-170
3.4.3	South Platte River Facilities .....	3-171
3.4.4	Denver Basin Aquifer Facilities .....	3-171
3.4.5	River Segments.....	3-172
3.4.5.1	Fraser River .....	3-173
3.4.5.2	Williams Fork River .....	3-207
3.4.5.3	Upper Colorado River .....	3-215
3.4.5.4	Blue River.....	3-215

# TABLE OF CONTENTS

---

3.4.5.5	South Boulder Creek.....	3-215
3.4.5.6	North Fork South Platte River and South Platte River .....	3-216
3.5	Geology.....	3-217
3.5.0	Overview.....	3-217
3.5.1	Reservoirs .....	3-217
3.5.1.1	Gross Reservoir.....	3-217
3.5.1.2	Leyden Gulch Reservoir Site .....	3-220
3.5.2	Conveyance Systems .....	3-222
3.5.2.1	Conduit M .....	3-222
3.5.2.2	Conduit O.....	3-224
3.5.3	South Platte River Facilities.....	3-225
3.5.4	Denver Basin Aquifer Facilities.....	3-226
3.6	Soils .....	3-229
3.6.0	Overview.....	3-229
3.6.1	Reservoirs .....	3-229
3.6.1.1	Gross Reservoir.....	3-229
3.6.1.2	Leyden Gulch Reservoir Site .....	3-230
3.6.2	Conveyance Systems .....	3-230
3.6.2.1	Conduit M .....	3-230
3.6.2.2	Conduit O.....	3-230
3.6.3	South Platte River Facilities.....	3-230
3.6.4	Denver Basin Aquifer Facilities.....	3-231
3.7	Vegetation .....	3-233
3.7.0	Overview.....	3-233
3.7.1	Reservoirs .....	3-239
3.7.1.1	Gross Reservoir.....	3-239
3.7.1.2	Leyden Gulch Reservoir Site .....	3-243
3.7.2	Conveyance Systems .....	3-246
3.7.2.1	Conduit M .....	3-246
3.7.2.2	Conduit O.....	3-247
3.7.3	South Platte River Facilities.....	3-247
3.7.4	Denver Basin Aquifer Facilities.....	3-249
3.8	Riparian and Wetland Areas .....	3-251
3.8.0	Overview.....	3-251
3.8.1	Reservoirs .....	3-267
3.8.1.1	Gross Reservoir.....	3-267
3.8.1.2	Leyden Gulch Reservoir Site .....	3-270
3.8.2	Conveyance Systems .....	3-274
3.8.2.1	Conduit M .....	3-274
3.8.2.2	Conduit O.....	3-277
3.8.3	South Platte River Facilities.....	3-279
3.8.4	Denver Basin Aquifer Facilities.....	3-283
3.8.5	River Segments .....	3-285
3.8.5.1	Fraser River.....	3-291
3.8.5.2	Williams Fork River .....	3-301

# TABLE OF CONTENTS

---

3.8.5.3	Colorado River .....	3-306
3.8.5.4	Blue River.....	3-309
3.8.5.5	South Boulder Creek .....	3-311
3.8.5.6	North Fork South Platte River.....	3-316
3.8.5.7	South Platte River.....	3-321
3.9	Wildlife.....	3-323
3.9.0	Overview .....	3-323
3.9.1	Reservoirs .....	3-323
3.9.1.1	Gross Reservoir .....	3-323
3.9.1.2	Leyden Gulch Reservoir Site.....	3-335
3.9.2	Conveyance Systems .....	3-344
3.9.2.1	Conduit M.....	3-347
3.9.2.2	Conduit O .....	3-351
3.9.3	South Platte River Facilities .....	3-352
3.9.3.1	Gravel Pits .....	3-352
3.9.4	Denver Basin Aquifer Facilities .....	3-353
3.9.5	River Segments.....	3-353
3.9.5.1	Fraser River .....	3-357
3.9.5.2	Williams Fork River .....	3-358
3.9.5.3	Colorado River .....	3-359
3.9.5.4	Blue River.....	3-359
3.9.5.5	South Boulder Creek .....	3-360
3.9.5.6	North Fork South Platte River.....	3-360
3.9.5.7	South Platte River.....	3-360
3.10	Special Status Species .....	3-363
3.10.0	Overview .....	3-363
3.10.1	Reservoirs .....	3-363
3.10.1.1	Gross Reservoir .....	3-364
3.10.1.2	Leyden Gulch Reservoir Site.....	3-370
3.10.2	Conveyance Systems .....	3-375
3.10.2.1	Conduit M.....	3-375
3.10.2.2	Conduit O .....	3-375
3.10.3	South Platte River Facilities .....	3-376
3.10.4	Denver Basin Aquifer Facilities .....	3-377
3.10.5	River Segments.....	3-378
3.10.5.1	Fraser River .....	3-378
3.10.5.2	Williams Fork River .....	3-380
3.10.5.3	Colorado River .....	3-382
3.10.5.4	Blue River.....	3-382
3.10.5.5	South Boulder Creek .....	3-383
3.10.5.6	North Fork South Platte River.....	3-384
3.10.5.7	South Platte River.....	3-385
3.10.5.8	Downstream Colorado River.....	3-386
3.10.5.9	Platte River (Central Nebraska).....	3-387

# **TABLE OF CONTENTS**

---

3.11 Aquatic Biological Resources.....	3-389
3.11.0 Overview.....	3-389
3.11.0.1 Habitat.....	3-389
3.11.0.2 Fish.....	3-390
3.11.0.3 Benthic Macroinvertebrates .....	3-392
3.11.1 Aquatic Ecological Context .....	3-393
3.11.1.1 Ecological Processes in Streams .....	3-393
3.11.1.2 Fish Life Histories.....	3-395
3.11.1.3 Temperature .....	3-397
3.11.1.4 Flushing Flows.....	3-398
3.11.1.5 Tipping Points.....	3-400
3.11.1.6 Mercury in Fish Tissue .....	3-405
3.11.1.7 Nuisance Species .....	3-406
3.11.2 Reservoirs .....	3-409
3.11.2.1 Gross Reservoir, Forsythe Canyon, and Winiger Gulch .....	3-409
3.11.2.2 Leyden Gulch Reservoir Site .....	3-411
3.11.3 Conveyance Systems .....	3-411
3.11.3.1 Conduit M .....	3-411
3.11.3.2 Conduit O.....	3-412
3.11.4 South Platte River Facilities.....	3-412
3.11.5 Denver Basin Aquifer Facilities.....	3-413
3.11.6 River Segments .....	3-413
3.11.6.1 Fraser River.....	3-415
3.11.6.2 Williams Fork River .....	3-455
3.11.6.3 Colorado River.....	3-465
3.11.6.4 Blue River .....	3-472
3.11.6.5 South Boulder Creek.....	3-478
3.11.6.6 North Fork South Platte River .....	3-483
3.11.6.7 South Platte River .....	3-486
3.12 Transportation.....	3-493
3.12.0 Overview.....	3-493
3.12.1 Reservoirs .....	3-495
3.12.1.1 Gross Reservoir.....	3-495
3.12.1.2 Leyden Gulch Reservoir Site .....	3-495
3.12.2 Conveyance Systems .....	3-495
3.12.3 South Platte River Facilities.....	3-495
3.12.4 Denver Basin Aquifer Facilities.....	3-498
3.13 Air Quality .....	3-499
3.13.0 Overview.....	3-499
3.13.1 National Ambient Air Quality Standards.....	3-499
3.13.2 Regional Haze/Visibility/Extinction .....	3-504
3.13.3 Status of State Implementation Plans .....	3-507
3.13.4 Air Quality Conformity.....	3-508

# TABLE OF CONTENTS

---

3.14	Noise.....	3-511
3.14.0	Overview .....	3-511
3.14.1	Reservoirs .....	3-515
3.14.1.1	Gross Reservoir .....	3-515
3.14.1.2	Leyden Gulch Reservoir Site.....	3-515
3.14.2	Conveyance Systems .....	3-516
3.14.3	South Platte River Facilities .....	3-516
3.14.4	Denver Basin Aquifer Facilities .....	3-516
3.15	Recreation.....	3-517
3.15.0	Overview .....	3-517
3.15.1	Reservoirs .....	3-517
3.15.1.1	Gross Reservoir .....	3-517
3.15.1.2	Leyden Gulch Reservoir Site.....	3-523
3.15.2	Conveyance Systems .....	3-523
3.15.2.1	Conduit M.....	3-523
3.15.2.2	Conduit O .....	3-524
3.15.3	South Platte River Facilities .....	3-524
3.15.4	Denver Basin Aquifer Facilities .....	3-525
3.15.5	River Segments.....	3-526
3.15.5.1	Fraser River .....	3-527
3.15.5.2	Williams Fork River .....	3-528
3.15.5.3	Colorado River .....	3-528
3.15.5.4	Blue River.....	3-529
3.15.5.5	South Boulder Creek .....	3-530
3.15.5.6	North Fork South Platte River .....	3-531
3.16	Land Use.....	3-533
3.16.0	Overview .....	3-533
3.16.1	Reservoirs .....	3-533
3.16.1.1	Gross Reservoir .....	3-533
3.16.1.2	Leyden Gulch Reservoir Site.....	3-537
3.16.2	Conveyance Systems .....	3-540
3.16.2.1	Conduit M.....	3-540
3.16.2.2	Conduit O .....	3-541
3.16.3	South Platte River Facilities .....	3-541
3.16.4	Denver Basin Aquifer Facilities .....	3-543
3.17	Visual Resources .....	3-545
3.17.0	Overview .....	3-545
3.17.1	Reservoirs .....	3-545
3.17.1.1	Gross Reservoir .....	3-545
3.17.1.2	Leyden Gulch Reservoir Site.....	3-548
3.17.2	Conveyance Systems .....	3-549
3.17.2.1	Conduit M.....	3-549
3.17.2.2	Conduit O .....	3-550
3.17.3	South Platte River Facilities .....	3-550
3.17.4	Denver Basin Aquifer Facilities .....	3-551
3.17.5	River Segments.....	3-551

---

## **TABLE OF CONTENTS**

---

3.18	Cultural/Historical/Paleontological Resources .....	3-553
3.18.0	Overview .....	3-553
3.18.1	Reservoirs .....	3-556
3.18.1.1	Gross Reservoir.....	3-556
3.18.1.2	Leyden Gulch Reservoir Site .....	3-558
3.18.2	Conveyance Systems .....	3-560
3.18.2.1	Conduit M .....	3-560
3.18.2.2	Conduit O.....	3-562
3.18.3	South Platte River Facilities.....	3-568
3.18.4	Denver Basin Aquifer Facilities.....	3-568
3.19	Socioeconomics .....	3-571
3.19.0	Overview .....	3-571
3.19.1	Reservoirs .....	3-573
3.19.1.1	Gross Reservoir.....	3-573
3.19.1.2	Leyden Gulch Reservoir Site .....	3-575
3.19.2	Conveyance Systems .....	3-576
3.19.2.1	Conduit M .....	3-576
3.19.2.2	Conduit O.....	3-577
3.19.3	South Platte River Facilities.....	3-577
3.19.3.1	South Platte River Facilities PIA .....	3-577
3.19.3.2	Water Rights Acquisition Area .....	3-580
3.19.4	Denver Basin Aquifer Facilities.....	3-581
3.19.4.1	Denver Basin Aquifer Facilities PIA .....	3-581
3.19.4.2	Advanced Water Treatment Plant.....	3-582
3.19.5	Secondary Impact Areas .....	3-585
3.19.5.1	Adams County .....	3-585
3.19.5.2	Boulder County .....	3-586
3.19.5.3	City of Brighton .....	3-587
3.19.5.4	Denver County .....	3-589
3.19.5.5	Denver Metropolitan Area .....	3-589
3.19.5.6	Grand County.....	3-590
3.19.5.7	Jefferson County .....	3-592
3.19.5.8	Weld County .....	3-593
3.20	Hazardous Materials .....	3-595
3.20.0	Overview .....	3-595
3.20.1	Reservoirs .....	3-596
3.20.1.1	Gross Reservoir.....	3-596
3.20.1.2	Leyden Gulch Reservoir Site .....	3-597
3.20.2	Conveyance Systems .....	3-599
3.20.2.1	Conduit M .....	3-599
3.20.2.2	Conduit O.....	3-599
3.20.3	South Platte River Facilities.....	3-600
3.20.4	Denver Basin Aquifer Storage Facilities .....	3-602

# **TABLE OF CONTENTS**

---

## **Volume 3 of 10**

<b>Chapter 4 – Total Environmental Effects .....</b>	<b>4-1</b>
4.0    Introduction .....	4-1
4.1    Methodology for Total Environmental Effects Analysis .....	4-3
4.2    Past Actions .....	4-7
4.2.1    Past Water-based Actions.....	4-7
4.2.2    Past Land-based Actions .....	4-8
4.3    Reasonably Foreseeable Future Actions .....	4-11
4.3.1    Future Water-based Actions .....	4-11
4.3.2    Future Land-based Actions.....	4-40
4.4    Climate Change and Water Resources .....	4-45
4.4.1    Relation of Rising Ambient Air Temperature and Water Resources in the West .....	4-45
4.4.2    Climate Change and Water Managers .....	4-45
4.5    Actions Not Considered Reasonably Foreseeable Future Actions.....	4-49
4.5.1    Water-based Actions .....	4-49
4.5.2    Land-based Actions .....	4-51
4.6    Evaluation of Total Environmental Effects .....	4-53
4.6.1    Surface Water .....	4-53
4.6.1.1    Proposed Action (Alternative 1a) with Reasonably Foreseeable Future Actions .....	4-61
4.6.1.2    Alternative 1c with Reasonably Foreseeable Future Actions .....	4-127
4.6.1.3    Alternative 8a with Reasonably Foreseeable Future Actions .....	4-132
4.6.1.4    Alternative 10a with Reasonably Foreseeable Future Actions .....	4-139
4.6.1.5    Alternative 13a with Reasonably Foreseeable Future Actions .....	4-140
4.6.1.6    No Action Alternative with Reasonably Foreseeable Future Actions .....	4-145
4.6.2    Water Quality .....	4-171
4.6.2.1    Proposed Action (Alternative 1a) with Reasonably Foreseeable Future Actions .....	4-177
4.6.2.2    Alternative 1c with Reasonably Foreseeable Future Actions .....	4-276
4.6.2.3    Alternative 8a with Reasonably Foreseeable Future Actions .....	4-278
4.6.2.4    Alternative 10a with Reasonably Foreseeable Future Actions .....	4-279
4.6.2.5    Alternative 13a with Reasonably Foreseeable Future Actions .....	4-279
4.6.2.6    No Action Alternative with Reasonably Foreseeable Future Actions .....	4-279

# TABLE OF CONTENTS

---

4.6.3	Channel Morphology .....	4-285
4.6.3.1	Methods for Historic Data Assessment.....	4-287
4.6.3.2	Review of Previous Studies .....	4-298
4.6.3.3	Sediment Supply Methodology.....	4-306
4.6.3.4	Methods for Quantitative Evaluation of Channel Morphology Analysis .....	4-310
4.6.3.5	Methods for Quantitative Impact Analyses .....	4-313
4.6.3.6	Methods for Geomorphologic Impacts at Representative Sites .....	4-316
4.6.3.7	Sediment Supply .....	4-326
4.6.3.8	Phase 2 Sediment Transport.....	4-331
4.6.3.9	Effective Discharge.....	4-351
4.6.3.10	Impact Summary .....	4-361
4.6.4	Groundwater .....	4-393
4.6.4.1	Proposed Action (Alternative 1a) with Reasonably Foreseeable Future Actions.....	4-395
4.6.4.2	Alternative 1c with Reasonably Foreseeable Future Actions .....	4-401
4.6.4.3	Alternative 8a with Reasonably Foreseeable Future Actions .....	4-402
4.6.4.4	Alternative 10a with Reasonably Foreseeable Future Actions .....	4-403
4.6.4.5	Alternative 13a with Reasonably Foreseeable Future Actions .....	4-404
4.6.4.6	No Action Alternative with Reasonably Foreseeable Future Actions .....	4-405
4.6.5	Geology .....	4-407
4.6.5.1	Proposed Action (Alternative 1a) with Reasonably Foreseeable Future Actions.....	4-407
4.6.5.2	Alternative 1c with Reasonably Foreseeable Future Actions .....	4-407
4.6.5.3	Alternative 8a with Reasonably Foreseeable Future Actions .....	4-408
4.6.5.4	Alternative 10a with Reasonably Foreseeable Future Actions .....	4-408
4.6.5.5	Alternative 13a with Reasonably Foreseeable Future Actions .....	4-408
4.6.5.6	No Action Alternative with Reasonably Foreseeable Future Actions .....	4-408
4.6.6	Soils.....	4-409
4.6.6.1	Proposed Action (Alternative 1a) with Reasonably Foreseeable Future Actions.....	4-409
4.6.6.2	Alternative 1c with Reasonably Foreseeable Future Actions .....	4-410
4.6.6.3	Alternative 8a with Reasonably Foreseeable Future Actions .....	4-410

# TABLE OF CONTENTS

---

4.6.6.4	Alternative 10a with Reasonably Foreseeable Future Actions .....	4-410
4.6.6.5	Alternative 13a with Reasonably Foreseeable Future Actions .....	4-411
4.6.6.6	No Action Alternative with Reasonably Foreseeable Future Actions .....	4-411
4.6.7	Vegetation.....	4-413
4.6.7.1	Proposed Action (Alternative 1a) with Reasonably Foreseeable Future Actions .....	4-413
4.6.7.2	Alternative 1c with Reasonably Foreseeable Future Actions .....	4-415
4.6.7.3	Alternative 8a with Reasonably Foreseeable Future Actions .....	4-415
4.6.7.4	Alternative 10a with Reasonably Foreseeable Future Actions .....	4-416
4.6.7.5	Alternative 13a with Reasonably Foreseeable Future Actions .....	4-416
4.6.7.6	No Action Alternative with Reasonably Foreseeable Future Actions .....	4-417
4.6.8	Riparian and Wetland Areas.....	4-419
4.6.8.1	Proposed Action (Alternative 1a) with Reasonably Foreseeable Future Actions .....	4-426
4.6.8.2	Alternative 1c with Reasonably Foreseeable Future Actions .....	4-449
4.6.8.3	Alternative 8a with Reasonably Foreseeable Future Actions .....	4-450
4.6.8.4	Alternative 10a with Reasonably Foreseeable Future Actions .....	4-451
4.6.8.5	Alternative 13a with Reasonably Foreseeable Future Actions .....	4-452
4.6.8.6	No Action Alternative with Reasonably Foreseeable Future Actions .....	4-453
4.6.9	Wildlife.....	4-455
4.6.9.1	Proposed Action (Alternative 1a) with Reasonably Foreseeable Future Actions .....	4-455
4.6.9.2	Alternative 1c with Reasonably Foreseeable Future Actions .....	4-458
4.6.9.3	Alternative 8a with Reasonably Foreseeable Future Actions .....	4-459
4.6.9.4	Alternative 10a with Reasonably Foreseeable Future Actions .....	4-459
4.6.9.5	Alternative 13a with Reasonably Foreseeable Future Actions .....	4-459
4.6.9.6	No Action Alternative with Reasonably Foreseeable Future Actions .....	4-460

## **TABLE OF CONTENTS**

---

4.6.10	Special Status Species.....	4-461
4.6.10.1	Proposed Action (Alternative 1a) with Reasonably Foreseeable Future Actions.....	4-461
4.6.10.2	Alternative 1c with Reasonably Foreseeable Future Actions .....	4-468
4.6.10.3	Alternative 8a with Reasonably Foreseeable Future Actions .....	4-468
4.6.10.4	Alternative 10a with Reasonably Foreseeable Future Actions .....	4-469
4.6.10.5	Alternative 13a with Reasonably Foreseeable Future Actions .....	4-470
4.6.10.6	No Action Alternative with Reasonably Foreseeable Future Actions .....	4-470
4.6.11	Aquatic Biological Resources.....	4-473
4.6.11.1	Proposed Action (Alternative 1a) with Reasonably Foreseeable Future Actions.....	4-481
4.6.11.2	Alternative 1c with Reasonably Foreseeable Future Actions .....	4-521
4.6.11.3	Alternative 8a with Reasonably Foreseeable Future Actions .....	4-522
4.6.11.4	Alternative 10a with Reasonably Foreseeable Future Actions .....	4-523
4.6.11.5	Alternative 13a with Reasonably Foreseeable Future Actions .....	4-524
4.6.11.6	No Action Alternative with Reasonably Foreseeable Future Actions .....	4-525
4.6.12	Transportation.....	4-531
4.6.12.1	Proposed Action (Alternative 1a) with Reasonably Foreseeable Future Actions.....	4-531
4.6.12.2	Alternative 1c with Reasonably Foreseeable Future Actions .....	4-532
4.6.12.3	Alternative 8a with Reasonably Foreseeable Future Actions .....	4-532
4.6.12.4	Alternative 10a with Reasonably Foreseeable Future Actions .....	4-533
4.6.12.5	Alternative 13a with Reasonably Foreseeable Future Actions .....	4-534
4.6.12.6	No Action Alternative with Reasonably Foreseeable Future Actions .....	4-534
4.6.13	Air Quality .....	4-535
4.6.13.1	Proposed Action (Alternative 1a) with Reasonably Foreseeable Future Actions.....	4-535
4.6.13.2	Alternative 1c with Reasonably Foreseeable Future Actions .....	4-535
4.6.13.3	Alternative 8a with Reasonably Foreseeable Future Actions .....	4-536

# TABLE OF CONTENTS

---

4.6.13.4	Alternative 10a with Reasonably Foreseeable Future Actions .....	4-536
4.6.13.5	Alternative 13a with Reasonably Foreseeable Future Actions .....	4-536
4.6.13.6	No Action Alternative with Reasonably Foreseeable Future Actions .....	4-536
4.6.14	Noise.....	4-537
4.6.14.1	Proposed Action (Alternative 1a) with Reasonably Foreseeable Future Actions .....	4-537
4.6.14.2	Alternative 1c with Reasonably Foreseeable Future Actions .....	4-538
4.6.14.3	Alternative 8a with Reasonably Foreseeable Future Actions .....	4-538
4.6.14.4	Alternative 10a with Reasonably Foreseeable Future Actions .....	4-538
4.6.14.5	Alternative 13a with Reasonably Foreseeable Future Actions .....	4-539
4.6.14.6	No Action Alternative with Reasonably Foreseeable Future Actions .....	4-539
4.6.15	Recreation.....	4-541
4.6.15.1	Proposed Action (Alternative 1a) with Reasonably Foreseeable Future Actions .....	4-541
4.6.15.2	River Segments.....	4-541
4.6.15.3	Alternative 1c with Reasonably Foreseeable Future Actions .....	4-549
4.6.15.4	Alternative 8a with Reasonably Foreseeable Future Actions .....	4-550
4.6.15.5	Alternative 10a with Reasonably Foreseeable Future Actions .....	4-550
4.6.15.6	Alternative 13a with Reasonably Foreseeable Future Actions .....	4-551
4.6.15.7	No Action Alternative with Reasonably Foreseeable Future Actions .....	4-552
4.6.15.8	Depletion of the Strategic Water Reserve Strategy.....	4-555
4.6.15.9	Combination Strategy.....	4-556
4.6.16	Land Use.....	4-561
4.6.16.1	Proposed Action (Alternative 1a) with Reasonably Foreseeable Future Actions .....	4-561
4.6.16.2	Alternative 1c with Reasonably Foreseeable Future Actions .....	4-562
4.6.16.3	Alternative 8a with Reasonably Foreseeable Future Actions .....	4-563
4.6.16.4	Alternative 10a with Reasonably Foreseeable Future Actions .....	4-563

## TABLE OF CONTENTS

---

4.6.16.5	Alternative 13a with Reasonably Foreseeable Future Actions .....	4-564
4.6.16.6	No Action Alternative with Reasonably Foreseeable Future Actions .....	4-564
4.6.17	Visual Resources.....	4-565
4.6.17.1	Proposed Action (Alternative 1a) with Reasonably Foreseeable Future Actions.....	4-565
4.6.17.2	Alternative 1c with Reasonably Foreseeable Future Actions .....	4-571
4.6.17.3	Alternative 8a with Reasonably Foreseeable Future Actions .....	4-571
4.6.17.4	Alternative 10a with Reasonably Foreseeable Future Actions .....	4-572
4.6.17.5	Alternative 13a with Reasonably Foreseeable Future Actions .....	4-572
4.6.17.6	No Action Alternative with Reasonably Foreseeable Future Actions .....	4-573
4.6.18	Cultural/Historical/Paleontological Resources .....	4-575
4.6.18.1	Proposed Action (Alternative 1a) with Reasonably Foreseeable Future Actions.....	4-575
4.6.18.2	Alternative 1c with Reasonably Foreseeable Future Actions .....	4-576
4.6.18.3	Alternative 8a with Reasonably Foreseeable Future Actions .....	4-576
4.6.18.4	Alternative 10a with Reasonably Foreseeable Future Actions .....	4-576
4.6.18.5	Alternative 13a with Reasonably Foreseeable Future Actions .....	4-577
4.6.18.6	No Action Alternative with Reasonably Foreseeable Future Actions .....	4-577
4.6.19	Socioeconomics .....	4-579
4.6.19.1	Proposed Action (Alternative 1a) with Reasonably Foreseeable Future Actions.....	4-579
4.6.19.2	Alternative 1c with Reasonably Foreseeable Future Actions .....	4-588
4.6.19.3	Alternative 8a with Reasonably Foreseeable Future Actions .....	4-590
4.6.19.4	Alternative 10a with Reasonably Foreseeable Future Actions .....	4-591
4.6.19.5	Alternative 13a with Reasonably Foreseeable Future Actions .....	4-593
4.6.19.6	No Action Alternative with Reasonably Foreseeable Future Actions .....	4-594
4.6.20	Hazardous Materials .....	4-599
4.6.20.1	Proposed Action (Alternative 1a) with Reasonably Foreseeable Future Actions.....	4-599

# **TABLE OF CONTENTS**

---

4.6.20.2 Alternative 1c with Reasonably Foreseeable Future Actions .....	4-599
4.6.20.3 Alternative 8a with Reasonably Foreseeable Future Actions .....	4-600
4.6.20.4 Alternative 10a with Reasonably Foreseeable Future Actions .....	4-600
4.6.20.5 Alternative 13a with Reasonably Foreseeable Future Actions .....	4-600
4.6.20.6 No Action Alternative with Reasonably Foreseeable Future Actions .....	4-600

## **Volume 4 of 10**

<b>Chapter 5 – Moffat Project Effects .....</b>	<b>5-1</b>
5.0 Introduction .....	5-1
5.1 Surface Water .....	5-7
5.1.1 Proposed Action (Alternative 1a) .....	5-11
5.1.1.1 Reservoir Evaporation and Fluctuation .....	5-11
5.1.1.2 River Segments.....	5-17
5.1.2 Alternative 1c .....	5-50
5.1.2.1 Reservoir Evaporation and Fluctuation .....	5-50
5.1.2.2 River Segments.....	5-52
5.1.3 Alternative 8a .....	5-55
5.1.3.1 Reservoir Evaporation and Fluctuation .....	5-56
5.1.3.2 River Segments.....	5-57
5.1.4 Alternative 10a .....	5-63
5.1.4.1 Reservoirs and River Segments.....	5-63
5.1.5 Alternative 13a .....	5-64
5.1.5.1 Reservoir Evaporation and Fluctuation .....	5-65
5.1.5.2 River Segments.....	5-66
5.1.6 No Action Alternative .....	5-69
5.1.6.1 Depletion of Strategic Water Reserve Strategy .....	5-69
5.1.6.2 Reservoir Evaporation and Fluctuation .....	5-70
5.1.6.3 River Segments.....	5-74
5.1.6.4 Combination Strategy .....	5-90
5.1.7 Mitigation and Monitoring .....	5-91
5.1.8 Unavoidable Adverse Impacts.....	5-91
5.2 Water Quality .....	5-93
5.2.1 Proposed Action (Alternative 1a) .....	5-99
5.2.1.1 Reservoir Water Quality.....	5-99
5.2.1.2 River Segments.....	5-103
5.2.2 Alternative 1c .....	5-114
5.2.2.1 Reservoir Water Quality.....	5-114
5.2.2.2 River Segments.....	5-115

## **TABLE OF CONTENTS**

---

5.2.3	Alternative 8a.....	5-115
5.2.3.1	Reservoir Evaporation and Fluctuation .....	5-115
5.2.3.2	River Segments .....	5-116
5.2.3.3	South Platte River Facilities.....	5-116
5.2.4	Alternative 10a.....	5-117
5.2.4.1	Reservoir Water Quality .....	5-117
5.2.4.2	River Segments .....	5-117
5.2.4.3	Denver Basin Aquifer Facilities.....	5-117
5.2.5	Alternative 13a.....	5-118
5.2.5.1	Reservoir Water Quality .....	5-118
5.2.5.2	River Segments .....	5-118
5.2.5.3	South Platte River Facilities.....	5-118
5.2.6	No Action Alternative.....	5-119
5.2.6.1	Depletion of Strategic Water Reserve Strategy .....	5-119
5.2.6.2	Reservoir Water Quality .....	5-119
5.2.6.3	River Segments .....	5-121
5.2.6.4	Combination Strategy .....	5-125
5.2.7	Mitigation and Monitoring.....	5-125
5.2.8	Unavoidable Adverse Impacts .....	5-126
5.3	Channel Morphology .....	5-127
5.3.1	Geomorphologic Impacts at Representative Reaches .....	5-127
5.3.1.1	Fraser River Basin.....	5-134
5.3.1.2	Williams Fork River Basin .....	5-135
5.3.1.3	Colorado River Basin.....	5-135
5.3.1.4	Blue River Basin .....	5-136
5.3.1.5	North Fork South Platte River Basin .....	5-136
5.3.1.6	South Boulder Creek Basin.....	5-136
5.3.1.7	Overall Bedload Transport Capacity Trends .....	5-137
5.3.2	Sediment Supply .....	5-137
5.3.2.1	Fraser River Basin.....	5-138
5.3.2.2	Williams Fork River Basin .....	5-139
5.3.2.3	Colorado River Basin.....	5-139
5.3.2.4	Blue River Basin .....	5-140
5.3.2.5	North Fork South Platte River Basin .....	5-140
5.3.2.6	South Boulder Creek Basin.....	5-140
5.3.2.7	Overall Sediment Supply Trends .....	5-140
5.3.3	Phase 2 Sediment Transport.....	5-141
5.3.3.1	Fraser River Basin.....	5-141
5.3.3.2	Williams Fork River Basin .....	5-144
5.3.3.3	Colorado River Basin.....	5-145
5.3.3.4	Blue River Basin .....	5-147
5.3.3.5	North Fork South Platte River Basin .....	5-148
5.3.3.6	South Boulder Creek Basin.....	5-149
5.3.3.7	Overall Phase 2 Sediment Transport Trends .....	5-150

# TABLE OF CONTENTS

---

5.3.4	Five-Year and 10-Year Flood Events .....	5-150
5.3.4.1	Fraser River Basin .....	5-151
5.3.4.2	Williams Fork River Basin .....	5-153
5.3.4.3	Colorado River Basin .....	5-153
5.3.4.4	Blue River Basin.....	5-154
5.3.4.5	North Fork South Platte River Basin.....	5-155
5.3.4.6	South Boulder Creek Basin .....	5-155
5.3.4.7	Overall Flood Event Trends .....	5-156
5.3.5	Effective Discharge .....	5-157
5.3.5.1	Fraser River Basin .....	5-157
5.3.5.2	Williams Fork River Basin.....	5-159
5.3.5.3	Colorado River Basin .....	5-160
5.3.5.4	Blue River Basin.....	5-161
5.3.5.5	North Fork South Platte River Basin.....	5-162
5.3.5.6	South Boulder Creek Basin .....	5-163
5.3.5.7	Overall Effective Discharge Trends .....	5-164
5.3.6	Impact Summary .....	5-164
5.3.6.1	Fraser River Basin .....	5-164
5.3.6.2	Williams Fork River Basin.....	5-174
5.3.6.3	Colorado River Basin .....	5-177
5.3.6.4	Blue River Basin.....	5-181
5.3.6.5	North Fork South Platte River Basin.....	5-183
5.3.6.6	South Boulder Creek Basin .....	5-186
5.3.7	Mitigation and Monitoring .....	5-189
5.3.8	Unavoidable Adverse Impacts.....	5-190
5.4	Groundwater .....	5-191
5.4.1	Proposed Action (Alternative 1a).....	5-191
5.4.1.1	Gross Reservoir .....	5-191
5.4.2	Alternative 1c .....	5-197
5.4.2.1	Gross Reservoir .....	5-197
5.4.2.2	Leyden Gulch Reservoir Site.....	5-197
5.4.2.3	River Segments.....	5-197
5.4.3	Alternative 8a .....	5-198
5.4.3.1	Gross Reservoir .....	5-198
5.4.3.2	South Platte River Facilities .....	5-198
5.4.3.3	Conduit O .....	5-199
5.4.3.4	River Segments.....	5-199
5.4.4	Alternative 10a .....	5-199
5.4.4.1	Gross Reservoir .....	5-199
5.4.4.2	Denver Basin Aquifer Facilities .....	5-199
5.4.4.3	Conduit M.....	5-200
5.4.4.4	River Segments.....	5-200
5.4.5	Alternative 13a .....	5-200
5.4.5.1	Gross Reservoir .....	5-200
5.4.5.2	South Platte River Facilities .....	5-200

## **TABLE OF CONTENTS**

---

5.4.5.3	Conduit O.....	5-201
5.4.5.4	River Segments .....	5-201
5.4.6	No Action Alternative.....	5-201
5.4.7	Mitigation and Monitoring.....	5-202
5.4.8	Unavoidable Adverse Impacts .....	5-202
5.5	Geology.....	5-203
5.5.1	Proposed Action (Alternative 1a) .....	5-203
5.5.1.1	Gross Reservoir.....	5-203
5.5.2	Alternative 1c.....	5-205
5.5.2.1	Gross Reservoir.....	5-205
5.5.2.2	Leyden Gulch Reservoir Site .....	5-205
5.5.3	Alternative 8a.....	5-206
5.5.3.1	Gross Reservoir.....	5-206
5.5.3.2	South Platte River Facilities.....	5-206
5.5.3.3	Conduit O.....	5-207
5.5.4	Alternative 10a.....	5-207
5.5.4.1	Gross Reservoir.....	5-207
5.5.4.2	Denver Basin Aquifer Facilities.....	5-207
5.5.4.3	Conduit M .....	5-207
5.5.5	Alternative 13a.....	5-207
5.5.5.1	Gross Reservoir.....	5-207
5.5.5.2	South Platte River Facilities.....	5-208
5.5.5.3	Conduit O.....	5-208
5.5.6	No Action Alternative.....	5-208
5.5.7	Mitigation and Monitoring.....	5-208
5.5.8	Unavoidable Adverse Impacts .....	5-209
5.6	Soils .....	5-211
5.6.1	Proposed Action (Alternative 1a) .....	5-211
5.6.1.1	Gross Reservoir.....	5-211
5.6.2	Alternative 1c.....	5-213
5.6.2.1	Gross Reservoir.....	5-213
5.6.2.2	Leyden Gulch Reservoir Site .....	5-213
5.6.3	Alternative 8a.....	5-214
5.6.3.1	Gross Reservoir.....	5-214
5.6.3.2	South Platte River Facilities.....	5-215
5.6.3.3	Conduit O.....	5-215
5.6.4	Alternative 10a.....	5-215
5.6.4.1	Gross Reservoir.....	5-215
5.6.4.2	Denver Basin Aquifer Facilities.....	5-215
5.6.4.3	Conduit M .....	5-216
5.6.5	Alternative 13a.....	5-216
5.6.5.1	Gross Reservoir.....	5-216
5.6.5.2	South Platte River Facilities.....	5-216
5.6.5.3	Conduit O.....	5-216

# **TABLE OF CONTENTS**

---

5.6.6	No Action Alternative .....	5-216
5.6.7	Mitigation and Monitoring .....	5-217
5.6.8	Unavoidable Adverse Impacts.....	5-217
5.7	Vegetation .....	5-219
5.7.1	Proposed Action (Alternative 1a).....	5-219
5.7.1.1	Gross Reservoir .....	5-219
5.7.2	Alternative 1c .....	5-224
5.7.2.1	Gross Reservoir .....	5-224
5.7.2.2	Leyden Gulch Reservoir Site.....	5-225
5.7.3	Alternative 8a .....	5-226
5.7.3.1	Gross Reservoir .....	5-226
5.7.3.2	South Platte River Facilities .....	5-227
5.7.3.3	Conduit O .....	5-228
5.7.4	Alternative 10a .....	5-229
5.7.4.1	Gross Reservoir .....	5-229
5.7.4.2	Denver Basin Aquifer Facilities .....	5-229
5.7.4.3	Conduit M.....	5-229
5.7.5	Alternative 13a .....	5-230
5.7.5.1	Gross Reservoir .....	5-230
5.7.5.2	South Platte River Facilities .....	5-231
5.7.5.3	Conduit O .....	5-232
5.7.6	No Action Alternative .....	5-232
5.7.7	Mitigation and Monitoring .....	5-232
5.7.8	Unavoidable Adverse Impacts.....	5-234
5.8	Riparian and Wetland Areas.....	5-235
5.8.1	Proposed Action (Alternative 1a).....	5-242
5.8.1.1	Gross Reservoir .....	5-242
5.8.1.2	River Segments.....	5-244
5.8.2	Alternative 1c .....	5-264
5.8.2.1	Gross Reservoir .....	5-264
5.8.2.2	Leyden Gulch Reservoir Site.....	5-265
5.8.2.3	River Segments.....	5-266
5.8.3	Alternative 8a .....	5-267
5.8.3.1	Gross Reservoir .....	5-267
5.8.3.2	South Platte River Facilities .....	5-268
5.8.3.3	Conduit O .....	5-269
5.8.3.4	River Segments.....	5-270
5.8.4	Alternative 10a .....	5-271
5.8.4.1	Gross Reservoir .....	5-271
5.8.4.2	Denver Basin Aquifer Facilities .....	5-271
5.8.4.3	Conduit M.....	5-271
5.8.4.4	River Segments.....	5-272
5.8.5	Alternative 13a .....	5-272
5.8.5.1	Gross Reservoir .....	5-272
5.8.5.2	South Platte River Facilities .....	5-273

## **TABLE OF CONTENTS**

---

	5.8.5.3 Conduit O.....	5-274
	5.8.5.4 River Segments .....	5-275
5.8.6	No Action Alternative.....	5-276
	5.8.6.1 Depletion of Strategic Water Reserve Strategy .....	5-276
	5.8.6.2 Combination Strategy .....	5-278
5.8.7	Mitigation and Monitoring.....	5-278
	5.8.7.1 Compensatory Mitigation .....	5-278
	5.8.7.2 Mitigation During Construction.....	5-279
	5.8.7.3 Alternative 1c – Leyden Gulch Reservoir Site .....	5-280
5.8.8	Unavoidable Adverse Impacts .....	5-280
5.9	Wildlife .....	5-281
5.9.1	Proposed Action (Alternative 1a) .....	5-281
	5.9.1.1 Gross Reservoir.....	5-281
	5.9.1.2 River Segments .....	5-290
5.9.2	Alternative 1c.....	5-292
	5.9.2.1 Gross Reservoir.....	5-292
	5.9.2.2 Leyden Gulch Reservoir Site .....	5-293
	5.9.2.3 River Segments .....	5-296
5.9.3	Alternative 8a.....	5-296
	5.9.3.1 Gross Reservoir.....	5-296
	5.9.3.2 South Platte River Facilities.....	5-297
	5.9.3.3 Conduit O.....	5-298
	5.9.3.4 River Segments .....	5-300
5.9.4	Alternative 10a.....	5-300
	5.9.4.1 Gross Reservoir.....	5-300
	5.9.4.2 Denver Basin Aquifer Facilities.....	5-300
	5.9.4.3 Conduit M .....	5-300
	5.9.4.4 River Segments .....	5-301
5.9.5	Alternative 13a.....	5-301
	5.9.5.1 Gross Reservoir.....	5-301
	5.9.5.2 South Platte River Facilities.....	5-302
	5.9.5.3 Conduit O.....	5-303
	5.9.5.4 River Segments .....	5-303
5.9.6	No Action Alternative.....	5-303
5.9.7	Mitigation and Monitoring.....	5-303
	5.9.7.1 Gravel Pit Habitat Management.....	5-305
	5.9.8 Unavoidable Adverse Impacts .....	5-306
5.10	Special Status Species.....	5-309
5.10.1	Proposed Action (Alternative 1a) .....	5-309
	5.10.1.1 Gross Reservoir.....	5-310
	5.10.1.2 River Segments .....	5-316
5.10.2	Alternative 1c.....	5-323
	5.10.2.1 Gross Reservoir.....	5-323
	5.10.2.2 Leyden Gulch Reservoir Site .....	5-324
	5.10.2.3 River Segments .....	5-325

# TABLE OF CONTENTS

---

5.10.3	Alternative 8a .....	5-326
5.10.3.1	Gross Reservoir .....	5-326
5.10.3.2	South Platte River Facilities .....	5-326
5.10.3.3	Conduit O .....	5-327
5.10.3.4	River Segments.....	5-328
5.10.4	Alternative 10a .....	5-329
5.10.4.1	Gross Reservoir .....	5-329
5.10.4.2	Denver Basin Aquifer Facilities .....	5-329
5.10.4.3	Conduit M.....	5-329
5.10.4.4	River Segments.....	5-330
5.10.5	Alternative 13a .....	5-330
5.10.5.1	Gross Reservoir .....	5-330
5.10.5.2	South Platte River Facilities .....	5-331
5.10.5.3	Conduit O .....	5-331
5.10.5.4	River Segments.....	5-331
5.10.6	No Action Alternative .....	5-331
5.10.7	Mitigation and Monitoring .....	5-332
5.10.8	Unavoidable Adverse Impacts.....	5-335
5.11	Aquatic Biological Resources .....	5-337
5.11.1	Proposed Action (Alternative 1a).....	5-345
5.11.1.1	Gross Reservoir .....	5-345
5.11.1.2	River Segments.....	5-346
5.11.2	Alternative 1c .....	5-383
5.11.2.1	Gross Reservoir .....	5-383
5.11.2.2	Leyden Gulch Reservoir Site.....	5-383
5.11.2.3	River Segments.....	5-384
5.11.3	Alternative 8a .....	5-384
5.11.3.1	Gross Reservoir .....	5-384
5.11.3.2	South Platte River Facilities .....	5-384
5.11.3.3	Conduit O .....	5-385
5.11.3.4	River Segments.....	5-385
5.11.4	Alternative 10a .....	5-385
5.11.4.1	Gross Reservoir .....	5-385
5.11.4.2	Denver Basin Aquifer Facilities .....	5-385
5.11.4.3	Conduit M.....	5-385
5.11.4.4	River Segments.....	5-385
5.11.5	Alternative 13a .....	5-385
5.11.5.1	Gross Reservoir .....	5-385
5.11.5.2	South Platte River Facilities .....	5-386
5.11.5.3	Conduit O .....	5-386
5.11.5.4	River Segments.....	5-386
5.11.6	No Action Alternative .....	5-386
5.11.6.1	Depletion of Strategic Water Reserve Strategy.....	5-386
5.11.6.2	Combination Strategy .....	5-390
5.11.7	Mitigation and Monitoring .....	5-390
5.11.8	Unavoidable Adverse Impacts.....	5-391

---

## TABLE OF CONTENTS

---

5.12	Transportation.....	5-393
5.12.1	Proposed Action (Alternative 1a) .....	5-395
5.12.2	Alternative 1c.....	5-399
5.12.2.1	Gross Reservoir.....	5-399
5.12.2.2	Leyden Gulch Reservoir Site .....	5-399
5.12.3	Alternative 8a.....	5-401
5.12.3.1	Gross Reservoir.....	5-401
5.12.3.2	South Platte River Facilities.....	5-401
5.12.4	Alternative 10a.....	5-403
5.12.4.1	Gross Reservoir.....	5-403
5.12.4.2	Denver Basin Aquifer Facilities.....	5-403
5.12.4.3	Conduit M .....	5-404
5.12.5	Alternative 13a.....	5-405
5.12.5.1	Gross Reservoir.....	5-405
5.12.5.2	South Platte River Facilities.....	5-405
5.12.5.3	Conduit O.....	5-405
5.12.6	No Action Alternative.....	5-405
5.12.7	Mitigation and Monitoring.....	5-405
5.12.8	Unavoidable Adverse Impacts .....	5-406
5.13	Air Quality .....	5-407
5.13.1	Proposed Action (Alternative 1a) .....	5-407
5.13.1.1	Gross Reservoir.....	5-407
5.13.2	Alternative 1c.....	5-409
5.13.2.1	Gross Reservoir.....	5-409
5.13.2.2	Leyden Gulch Reservoir Site .....	5-410
5.13.3	Alternative 8a.....	5-411
5.13.3.1	Gross Reservoir.....	5-411
5.13.3.2	South Platte River Facilities.....	5-411
5.13.4	Alternative 10a.....	5-412
5.13.4.1	Gross Reservoir.....	5-412
5.13.4.2	Denver Basin Aquifer Facilities.....	5-413
5.13.5	Alternative 13a.....	5-414
5.13.5.1	Gross Reservoir.....	5-414
5.13.5.2	South Platte River Facilities.....	5-414
5.13.6	No Action Alternative.....	5-415
5.13.7	Mitigation and Monitoring.....	5-416
5.13.8	Unavoidable Adverse Impacts .....	5-417
5.14	Noise .....	5-419
5.14.1	Proposed Action (Alternative 1a) .....	5-420
5.14.2	Alternative 1c.....	5-422
5.14.2.1	Gross Reservoir.....	5-422
5.14.2.2	Leyden Gulch Reservoir Site .....	5-423
5.14.3	Alternative 8a.....	5-423
5.14.3.1	Gross Reservoir.....	5-423
5.14.3.2	South Platte River Facilities.....	5-423
5.14.3.3	Conduit O.....	5-423

# TABLE OF CONTENTS

---

5.14.4	Alternative 10a .....	5-424
5.14.4.1	Gross Reservoir .....	5-424
5.14.4.2	Denver Basin Aquifer Facilities .....	5-424
5.14.4.3	Conduit M .....	5-424
5.14.5	Alternative 13a .....	5-424
5.14.5.1	Gross Reservoir .....	5-424
5.14.5.2	South Platte River Facilities .....	5-425
5.14.5.3	Conduit O .....	5-425
5.14.6	No Action Alternative .....	5-425
5.14.7	Mitigation and Monitoring .....	5-425
5.14.8	Unavoidable Adverse Impacts.....	5-425
5.15	Recreation.....	5-427
5.15.1	Proposed Action (Alternative 1a) .....	5-427
5.15.1.1	Gross Reservoir .....	5-427
5.15.1.2	River Segments.....	5-436
5.15.2	Alternative 1c .....	5-443
5.15.2.1	Gross Reservoir .....	5-443
5.15.2.2	Leyden Gulch Reservoir Site.....	5-443
5.15.2.3	River Segments.....	5-444
5.15.3	Alternative 8a .....	5-444
5.15.3.1	Gross Reservoir .....	5-444
5.15.3.2	South Platte River Facilities .....	5-444
5.15.3.3	Conduit O .....	5-445
5.15.3.4	River Segments.....	5-446
5.15.4	Alternative 10a .....	5-446
5.15.4.1	Gross Reservoir .....	5-446
5.15.4.2	Denver Basin Aquifer Facilities .....	5-446
5.15.4.3	Conduit M .....	5-446
5.15.4.4	River Segments.....	5-446
5.15.5	Alternative 13a .....	5-447
5.15.5.1	Gross Reservoir .....	5-447
5.15.5.2	South Platte River Facilities .....	5-447
5.15.5.3	Conduit O .....	5-447
5.15.5.4	River Segments.....	5-447
5.15.6	No Action Alternative .....	5-447
5.15.7	Mitigation and Monitoring .....	5-447
5.15.8	Unavoidable Adverse Impacts.....	5-448
5.16	Land Use.....	5-449
5.16.1	Proposed Action (Alternative 1a) .....	5-450
5.16.1.1	Gross Reservoir .....	5-450
5.16.2	Alternative 1c .....	5-452
5.16.2.1	Gross Reservoir .....	5-452
5.16.2.2	Leyden Gulch Reservoir Site.....	5-452
5.16.3	Alternative 8a .....	5-454
5.16.3.1	Gross Reservoir .....	5-454

## **TABLE OF CONTENTS**

---

5.16.3.2	South Platte River Facilities.....	5-454
5.16.3.3	Conduit O.....	5-455
5.16.4	Alternative 10a.....	5-455
5.16.4.1	Gross Reservoir.....	5-455
5.16.4.2	Denver Basin Aquifer Facilities.....	5-455
5.16.4.3	Conduit M.....	5-456
5.16.5	Alternative 13a.....	5-456
5.16.5.1	Gross Reservoir.....	5-456
5.16.5.2	South Platte River Facilities.....	5-456
5.16.5.3	Conduit O.....	5-457
5.16.6	No Action Alternative.....	5-457
5.16.7	Mitigation and Monitoring.....	5-457
5.16.8	Unavoidable Adverse Impacts .....	5-457
5.17	Visual Resources.....	5-459
5.17.1	Proposed Action (Alternative 1a) .....	5-460
5.17.1.1	Gross Reservoir.....	5-460
5.17.1.2	River Segments .....	5-465
5.17.2	Alternative 1c.....	5-468
5.17.2.1	Gross Reservoir.....	5-468
5.17.2.2	Leyden Gulch Reservoir Site .....	5-468
5.17.2.3	River Segments .....	5-470
5.17.3	Alternative 8a.....	5-472
5.17.3.1	Gross Reservoir.....	5-472
5.17.3.2	South Platte River Facilities.....	5-472
5.17.3.3	Conduit O.....	5-473
5.17.3.4	River Segments .....	5-473
5.17.4	Alternative 10a.....	5-474
5.17.4.1	Gross Reservoir.....	5-474
5.17.4.2	Denver Basin Aquifer Facilities.....	5-474
5.17.4.3	Conduit M .....	5-474
5.17.4.4	River Segments .....	5-475
5.17.5	Alternative 13a.....	5-475
5.17.5.1	Gross Reservoir.....	5-475
5.17.5.2	South Platte River Facilities.....	5-475
5.17.5.3	Conduit O.....	5-475
5.17.5.4	River Segments .....	5-475
5.17.6	No Action Alternative.....	5-475
5.17.7	Mitigation and Monitoring.....	5-476
5.17.8	Unavoidable Adverse Impacts .....	5-477
5.18	Cultural/Historical/Paleontological Resources .....	5-479
5.18.1	Proposed Action (Alternative 1a) .....	5-480
5.18.1.1	Gross Reservoir.....	5-480
5.18.2	Alternative 1c.....	5-480
5.18.2.1	Gross Reservoir.....	5-480
5.18.2.2	Leyden Gulch Reservoir Site .....	5-480

# TABLE OF CONTENTS

---

5.18.3	Alternative 8a .....	5-482
5.18.3.1	Gross Reservoir .....	5-482
5.18.3.2	South Platte River Facilities .....	5-482
5.18.3.3	Conduit O .....	5-482
5.18.4	Alternative 10a .....	5-483
5.18.4.1	Gross Reservoir .....	5-483
5.18.4.2	Denver Basin Aquifer Facilities .....	5-483
5.18.4.3	Conduit M.....	5-485
5.18.5	Alternative 13a .....	5-485
5.18.5.1	Gross Reservoir .....	5-485
5.18.5.2	South Platte River Facilities .....	5-485
5.18.5.3	Conduit O .....	5-486
5.18.6	No Action Alternative .....	5-486
5.18.7	Mitigation and Monitoring .....	5-486
5.18.8	Unavoidable Adverse Impacts.....	5-486
5.19	Socioeconomics.....	5-487
5.19.1	Proposed Action (Alternative 1a).....	5-488
5.19.1.1	Economic Conditions .....	5-488
5.19.1.2	Demographic Conditions.....	5-496
5.19.1.3	Environmental Justice .....	5-501
5.19.1.4	Housing Conditions .....	5-502
5.19.1.5	Fiscal Conditions of Public Entities Other than Denver Water .....	5-504
5.19.1.6	Public Facilities and Services .....	5-506
5.19.1.7	Financial Impacts to Denver Water Customers.....	5-511
5.19.1.8	Summary of Socioeconomic Impacts of the Proposed Action .....	5-512
5.19.2	Alternative 1c .....	5-514
5.19.2.1	Economic Conditions .....	5-514
5.19.2.2	Demographic Conditions.....	5-518
5.19.2.3	Environmental Justice .....	5-519
5.19.2.4	Housing Conditions .....	5-519
5.19.2.5	Fiscal Conditions of Public Entities Other than Denver Water .....	5-520
5.19.2.6	Public Facilities and Services .....	5-521
5.19.2.7	Financial Impacts to Denver Water Customers.....	5-525
5.19.2.8	Summary of Socioeconomic Impacts of Alternative 1c .....	5-526
5.19.3	Alternative 8a .....	5-527
5.19.3.1	Economic Conditions .....	5-527
5.19.3.2	Demographic Conditions.....	5-531
5.19.3.3	Environmental Justice .....	5-532
5.19.3.4	Housing Conditions .....	5-532
5.19.3.5	Fiscal Impacts of Public Entities Other than Denver Water .....	5-533
5.19.3.6	Public Facilities and Services .....	5-534

## **TABLE OF CONTENTS**

---

5.19.3.7	Financial Impacts to Denver Water Customers .....	5-538
5.19.3.8	Summary of Socioeconomic Impacts of Alternative 8a.....	5-539
5.19.4	Alternative 10a.....	5-540
5.19.4.1	Economic Conditions.....	5-540
5.19.4.2	Demographic Conditions .....	5-544
5.19.4.3	Environmental Justice .....	5-545
5.19.4.4	Housing Conditions .....	5-545
5.19.4.5	Fiscal Impacts of Public Entities Other than Denver Water.....	5-546
5.19.4.6	Public Facilities and Services .....	5-547
5.19.4.7	Financial Impacts to Denver Water Customers .....	5-551
5.19.4.8	Summary of Socioeconomic Impacts of Alternative 10a.....	5-551
5.19.5	Alternative 13a.....	5-553
5.19.5.1	Economic Conditions.....	5-553
5.19.5.2	Demographic Conditions .....	5-558
5.19.5.3	Environmental Justice .....	5-560
5.19.5.4	Housing Conditions .....	5-560
5.19.5.5	Fiscal Impacts of Public Entities Other than Denver Water.....	5-561
5.19.5.6	Public Facilities and Services .....	5-562
5.19.5.7	Financial Impacts to Denver Water Customers .....	5-565
5.19.5.8	Summary of Socioeconomic Impacts of Alternative 13a.....	5-566
5.19.6	No Action Alternative.....	5-568
5.19.6.1	Vulnerability and Risk .....	5-568
5.19.6.2	Raw Water Shortages.....	5-569
5.19.6.3	Treated Water Shortages .....	5-572
5.19.6.4	Drawdown of Gross Reservoir.....	5-574
5.19.6.5	Financial Impacts to Denver Water Customers .....	5-575
5.19.6.6	Summary of Socioeconomic Impacts of the No Action Alternative.....	5-576
5.19.7	Comparison of Major Aspects of the Socioeconomic Analysis.....	5-577
5.20	Hazardous Materials .....	5-579
5.20.1	Proposed Action (Alternative 1a) .....	5-579
5.20.1.1	Gross Reservoir.....	5-579
5.20.2	Alternative 1c.....	5-580
5.20.2.1	Gross Reservoir.....	5-580
5.20.2.2	Leyden Gulch Reservoir Site .....	5-580
5.20.3	Alternative 8a.....	5-581
5.20.3.1	Gross Reservoir.....	5-581
5.20.3.2	South Platte River Facilities.....	5-581

# **TABLE OF CONTENTS**

---

5.20.4	Alternative 10a .....	5-583
5.20.4.1	Gross Reservoir .....	5-583
5.20.4.2	Denver Basin Aquifer Facilities .....	5-583
5.20.5	Alternative 13a .....	5-583
5.20.5.1	Gross Reservoir .....	5-583
5.20.5.2	South Platte River Facilities .....	5-583
5.20.6	No Action Alternative .....	5-584
5.20.7	Mitigation and Monitoring .....	5-584
5.20.7.1	Avoidance, Minimization and Mitigation Measures by Alternative.....	5-584
5.20.8	Unavoidable and Adverse Impacts .....	5-586
5.21	Irreversible or Irretrievable Commitment of Resources.....	5-587
5.22	Comparison of Alternatives.....	5-589
<b>Chapter 6 – Consultation and Coordination .....</b>		<b>6-1</b>
6.1	Agency and Public Participation Summary.....	6-1
6.1.1	Scoping .....	6-1
6.1.2	Cooperating/Consulting Agency Preliminary Draft EIS .....	6-2
6.1.3	Draft EIS Public Hearings and Comment Period .....	6-3
6.1.4	Comments Received on the Draft EIS.....	6-5
6.2	Consultation.....	6-7
6.2.1	Native American Tribes Coordination .....	6-7
6.3	List of Reviewers and Preparers.....	6-9
6.4	List of Agencies, Organizations, and Persons to Whom Copies of the Final EIS were Sent and Locations Where the Final EIS Can be Reviewed.....	6-13
<b>References.....</b>		<b>References 1</b>

# TABLE OF CONTENTS

---

## List of Tables

Table ES-1	Comparison of Average Annual Flows, Reservoir Outflows, and Diversions at Key Locations .....	ES-33
Table ES-2	Total Permanent Impacts to Wetlands, Other Waters of the U.S. and Riparian Areas.....	ES-48
Table ES-3	Total Temporary Impacts to Wetlands, Other Waters of the U.S. and Riparian Areas.....	ES-48
Table ES-4	Direct Impacts to Wildlife Habitat in Gross Reservoir Study Area by Alternative.....	ES-51
Table ES-5	Direct Impacts to Wildlife Habitat at the Leyden Gulch Reservoir Site.....	ES-52
Table 1-1	Summary of Denver Water's Planning Estimates .....	1-15
Table 1-2	Summary of Conservation Measures (1980-2011).....	1-18
Table 1-3	Yield of Denver Water's System .....	1-22
Table 1-4	Representative System Refinement Projects .....	1-24
Table 1-5	Environmental Permits and Approvals Likely Required to Construct and Operate the Moffat Collection System Project.....	1-29
Table 2-1	Screen 1a Criteria.....	2-4
Table 2-2	Description of Water Supply Sources and Infrastructure Components in the "Long List" .....	2-8
Table 2-3	Screen 1a Summary .....	2-9
Table 2-4	Project Alternatives Evaluated in Screen 1b.....	2-11
Table 2-5	Relative Cost of Project Alternatives.....	2-17
Table 2-6	List of Alternatives Evaluated in Screen 2 .....	2-18
Table 2-7	Screen 2 Comparative Ranking Summary .....	2-21
Table 2-8	List of EIS Alternatives .....	2-23
Table 2-9	Denver Water's Estimated Unused Reusable Water .....	2-29
Table 2-10	Proposed Action (Alternative 1a) – Primary Components .....	2-35
Table 2-11	Comparison of Gross Dam and Reservoir Features by Alternative.....	2-44
Table 2-12	Alternative 1c – Primary Components.....	2-62
Table 2-13	Alternative 8a – Primary Components.....	2-76
Table 2-14	Alternative 10a – Primary Components.....	2-92

# **TABLE OF CONTENTS**

---

Table 2-15	Alternative 13a – Primary Components .....	2-102
Table 2-16	Estimated Construction Schedule by Alternative .....	2-112
Table 2-17	Typical Construction Sequences .....	2-113
Table 2-18	Estimated On-Site Construction Equipment .....	2-116
Table 2-19	Estimated One Way Vehicle Trips .....	2-117
Table 2-20	Construction Manpower Estimate (Full-time Equivalent Workers) .....	2-117
Table 2-21	Summary of Estimated Costs of Each Action Alternative .....	2-119
Table 2-22	Summary of Monthly Drought Restrictions (2002 through 2005).....	2-126
Table 2-23	Summary of Monthly Water Demand Reductions (2002 through 2005) .....	2-128
Table 2-24	Summary of Denver Water's Supply and Demand .....	2-129
Table 2-25	Summary of Major Characteristics and Impacts of Alternatives .....	2-134
Table 3.0-1	River Segments Study Area.....	3-7
Table 3.1-1	Denver Water Gross Reservoir Storage Rights .....	3-22
Table 3.1-2	Conduit M Stream Crossings.....	3-23
Table 3.1-3	Conduit O Stream Crossings .....	3-24
Table 3.1-4	Gravel Pit Pipeline Stream Crossings.....	3-25
Table 3.1-5	Denver Basin Aquifer Storage and Recovery Pipeline Stream Crossings .....	3-26
Table 3.1-6	Moffat Collection System Diversion Points on Fraser River Tributaries.....	3-28
Table 3.1-7	Denver Water Fraser River Basin Water Rights at Existing Structures .....	3-29
Table 3.1-8	Moffat Collection System Minimum Bypass Requirements.....	3-30
Table 3.1-9	Summary of Historical Bypass Flow Reduction in the Fraser River Basin .....	3-31
Table 3.1-10	Colorado Water Conservation Board Minimum Instream Flow Rights below Moffat Collection System .....	3-32
Table 3.1-11	Summary of Average Annual Stream Flow and Depletions for the Fraser River Near Winter Park Gage for the Period from 1975 through 2004.....	3-34

## **TABLE OF CONTENTS**

---

Table 3.1-12	Denver Water Williams Fork River Basin Water Rights at Existing Structures .....	3-39
Table 3.1-13	Colorado Water Conservation Board Minimum Instream Flow Rights below Williams Fork Collection System.....	3-40
Table 3.1-14	Summary of Average Annual Stream Flow and Depletions for the Colorado River at Windy Gap Gage for the Period from 1985 through 2004 .....	3-45
Table 3.1-15	Denver Water Blue River Basin Water Rights at Existing Structures .....	3-49
Table 3.1-16	Colorado Water Conservation Board Minimum Instream Flow Rights on Blue River below Dillon Reservoir .....	3-49
Table 3.1-17	Denver Water South Boulder Creek Basin Water Rights at Existing Structures .....	3-52
Table 3.2-1	Stream Classifications in the Moffat Project Area .....	3-62
Table 3.2-2	Gross Reservoir Water Quality .....	3-66
Table 3.2-3	Selected Water Quality Parameters in the Three Lakes.....	3-69
Table 3.2-4	Summary of Fraser River Water Quality Presented in the Grand County Stream Management Plan .....	3-73
Table 3.2-5	Fraser River Water Quality .....	3-83
Table 3.2-6	Vasquez Creek Water Quality .....	3-85
Table 3.2-7	St. Louis Creek Water Quality .....	3-88
Table 3.2-8	Water Quality Data from Denver Water Sampling Stations for the Williams Fork River.....	3-91
Table 3.2-9	USGS Data on the Williams Fork River.....	3-96
Table 3.2-10	Dissolved Oxygen below Williams Fork Reservoir .....	3-96
Table 3.2-11	Summary of Colorado River Water Quality in the Grand County Stream Management Plan .....	3-99
Table 3.2-12	Water Quality Data for the Colorado River from Granby to Kremmling .....	3-104
Table 3.2-13	Summary of Muddy Creek Water Quality in the Grand County Stream Management Plan .....	3-106
Table 3.2-14	Muddy Creek Water Quality Data .....	3-107
Table 3.2-15	Wastewater Treatment Facilities on the Blue River .....	3-109
Table 3.2-16	Summary of Blue River Water Quality in the Grand County Stream Management Plan .....	3-110

# **TABLE OF CONTENTS**

---

Table 3.2-17	Water Quality in the Blue River Downstream of Dillon Reservoir.....	3-111
Table 3.2-18	Water Quality Data for South Boulder Creek Near Moffat Tunnel.....	3-115
Table 3.2-19	Water Quality Data for North Fork South Platte River Near Roberts Tunnel .....	3-118
Table 3.2-20	Water Quality in the South Platte River below Spinney Reservoir (CDPHE Station 5952) .....	3-123
Table 3.2-21	Water Quality in the South Platte River at WS-UP-008 .....	3-125
Table 3.2-22	South Platte River Water Quality at Mineral Avenue Upstream of the Littleton-Englewood Wastewater Treatment Plant .....	3-127
Table 3.2-23	South Platte River Water Quality Upstream and Downstream of the Metro Wastewater Treatment Plant Discharge.....	3-130
Table 3.2-24	Stream Segments Outside the Project Area.....	3-133
Table 3.3-1	Stream Channel Characteristics of Affected River Segments .....	3-137
Table 3.3-2	Attributes of Representative Sampling Sites in the Fraser River Basin .....	3-146
Table 3.3-3	Attributes of Representative Sampling Sites in the Williams Fork River Basin.....	3-149
Table 3.3-4	Attributes of Representative Sampling Sites in the Colorado River Basin .....	3-151
Table 3.3-5	Attributes of Representative Sampling Site in the Blue River Basin .....	3-152
Table 3.3-6	Attributes of Representative Sampling Sites in the South Boulder Creek Basin.....	3-154
Table 3.3-7	Attributes of Representative Sampling Sites in the North Fork South Platte River Basin.....	3-157
Table 3.3-8	Attributes of Reconnaissance Sites in the Fraser River Basin .....	3-160
Table 3.3-9	Attributes of Reconnaissance Sites in the Williams Fork River Basin .....	3-162
Table 3.3-10	Attributes of Reconnaissance Sites in the Blue River Basin .....	3-164
Table 3.3-11	Attributes of Reconnaissance Site in the South Boulder Creek Basin .....	3-165
Table 3.3-12	Attributes of Reconnaissance Sites in the North Fork South Platte River Basin .....	3-166

## **TABLE OF CONTENTS**

---

Table 3.4-1	Summary of Stream and Groundwater Levels.....	3-198
Table 3.7-1	Noxious Weeds Observed or Expected to be Present in the Project Area .....	3-238
Table 3.8-1	Summary of Riparian Areas and Wetlands in the East Slope Study Areas.....	3-255
Table 3.8-2	Summary of Other Water Features in the East Slope Study Areas .....	3-267
Table 3.8-3	Summary of Riparian Areas and Wetlands in the Gross Reservoir Study Area.....	3-267
Table 3.8-4	Summary of Riparian Areas and Wetlands in the Leyden Gulch Study Area .....	3-271
Table 3.8-5	Summary of Riparian Areas and Wetlands Associated with South Platte River Facilities.....	3-280
Table 3.8-6	Summary of Riparian Areas and Wetlands along the Denver Basin Aquifer Facilities Distribution Pipeline .....	3-284
Table 3.8-7	Acreage of CPW Riparian Vegetation Types Along the River Segments .....	3-287
Table 3.8-8	Riparian Data from Grand County Stream Management Plan .....	3-289
Table 3.8-9	Acreage of CNHP Groups/Plant Associations: Sampling Sites FR1, FR3, and FR4 on the Upper Reach of the Fraser River .....	3-293
Table 3.8-10	Acreage of CNHP Groups/Plant Associations: Sampling Site FR2 on the Fraser Canyon Reach of the Fraser River .....	3-297
Table 3.8-11	Summary of Diverted Streams in the Fraser River Valley .....	3-300
Table 3.8-12	Acreage of CNHP Groups/Plant Associations: Sampling Site WF1 on the Williams Fork River.....	3-302
Table 3.8-13	Acreage of CNHP Groups/Plant Associations: Sampling Site WF2 on the Williams Fork River.....	3-304
Table 3.8-14	Acreage of CNHP Groups/Plant Associations: Sampling Site CR1 on the Colorado River.....	3-307
Table 3.8-15	Acreage of CNHP Groups/Plant Associations: Sampling Site BR1 on the Blue River.....	3-310
Table 3.8-16	Acreage of CNHP Groups/Plant Associations: Sampling Site SBC1 on South Boulder Creek .....	3-313
Table 3.8-17	Acreage of CNHP Groups/Plant Associations: Sampling Site SBC3 on South Boulder Creek .....	3-315

# **TABLE OF CONTENTS**

---

Table 3.8-18	Acreage of CNHP Groups/Plant Associations: Sampling Site NF1 on the North Fork South Platte River.....	3-318
Table 3.8-19	Acreage of CNHP Groups/Plant Associations: Sampling Site NF2 on the North Fork .....	3-320
Table 3.9-1	Raptors Likely or Known to Occur in the Gross Reservoir Study Area .....	3-330
Table 3.9-2	Common Songbirds in the Gross Reservoir Study Area by Habitat Type .....	3-331
Table 3.9-3	Management Indicator Species for the Arapaho & Roosevelt National Forests.....	3-332
Table 3.9-4	Birds Observed or Likely Present in the Leyden Gulch Site.....	3-343
Table 3.9-5	Common Wildlife Species that Occur in the Conveyance System Study Areas.....	3-344
Table 3.9-6	Waterfowl and Shorebirds Dependent on South Platte River Corridor during Winter or Migration .....	3-349
Table 3.9-7	Bird Species Breeding in Riparian and Wetland Habitats along the River Segments .....	3-354
Table 3.9-8	Mammal Species Likely or Known to Occur in Riparian and Wetland Habitats along the River Segments .....	3-356
Table 3.11-1	Fish Species Collected and Stocked in the Moffat Collection System Project Area .....	3-390
Table 3.11-2	Invertebrate Classes/Orders Collected in the Moffat Collection System Project Area .....	3-392
Table 3.11-3	Gross Reservoir Fish Population Data, Percent of Total Catch (1982 to 2010) .....	3-410
Table 3.11-4	Streams and Stream Segments in the Overall Study Area .....	3-414
Table 3.11-5	Fraser River Mainstem, Downstream of Denver Water Diversion, Fish Population Data, Percent of Total Catch, and Summary Parameters (1985 to 2010) .....	3-419
Table 3.11-6	Fraser River Mainstem, Downstream of Denver Water Diversion, Macroinvertebrate Population Data Summary Parameters (1985 to 2011).....	3-421
Table 3.11-7	Fraser River Tributary Streams Data Availability Upstream and Downstream of Existing Denver Water Diversions .....	3-423

## **TABLE OF CONTENTS**

---

Table 3.11-8	Fraser River Tributary Streams in the Project Area with Benthic Macroinvertebrate Population Parameters Downstream of Existing Denver Water Moffat Collection System Diversions (Samples from 2005).....	3-427
Table 3.11-9	St. Louis Creek, Downstream of Denver Water Diversion, Fish Population Data, Percent of Total Catch, and Summary Parameters (1993 to 2005) .....	3-429
Table 3.11-10	St. Louis Creek, Downstream of Denver Water Diversion, Macroinvertebrate Population Data Summary Parameters (1997 to 2004).....	3-430
Table 3.11-11	Main Elk Creek, Downstream of Denver Water Diversion, Macroinvertebrate Population Data Summary Parameters (2005 to 2010).....	3-435
Table 3.11-12	Vasquez Creek, Downstream of Denver Water Diversion, Fish Population Data, Percent of Total Catch, and Summary Parameters (1978 to 2009) .....	3-437
Table 3.11-13	Vasquez Creek, Upstream and Downstream of Denver Water Diversion, Macroinvertebrate Population Data Summary Parameters (1985 to 2011) .....	3-438
Table 3.11-14	Little Vasquez Creek, Downstream of Denver Water Diversion, Fish Population Data, Percent of Total Catch, and Summary Parameters (1982 to 2006) .....	3-439
Table 3.11-15	Jim Creek, Downstream of Denver Water Diversion, Fish Population Data, Percent of Total Catch, and Summary Parameters (1993 and 2005) .....	3-442
Table 3.11-16	Main Ranch Creek, Downstream and Upstream of Denver Water Diversion, Fish Population Data, Percent of Total Catch, and Summary Parameters (1978 to 2005).....	3-444
Table 3.11-17	Main Ranch Creek, Downstream of Denver Water Diversion, Macroinvertebrate Population Data Summary Parameters (2005 to 2010).....	3-445
Table 3.11-18	South Fork Ranch Creek, Upstream of Denver Water Diversion, Fish Population Data, Percent of Total Catch, and Summary Parameters (2003).....	3-447
Table 3.11-19	Meadow Creek, Downstream of Denver Water Diversion, Fish Population Data, Percent of Total Catch, and Summary Parameters (1993, 2005, and 2006) .....	3-449
Table 3.11-20	Williams Fork River, Upstream of the South Fork Williams Fork, Fish Population Data, Percent of Total Catch, and Summary Parameters (1993 to 2007) .....	3-457

## **TABLE OF CONTENTS**

---

Table 3.11-21	Williams Fork River, Downstream of Denver Water Diversions, Macroinvertebrate Population Data Summary Parameters (1984 to 2006).....	3-458
Table 3.11-22	Bobtail Creek, Upstream of Denver Water Diversion, Fish Population Data, Percent of Total Catch, and Summary Parameters (1984 to 2003).....	3-462
Table 3.11-23	Steelman Creek, Upstream of Denver Water Diversion, Fish Population Data, Percent of Total Catch, and Summary Parameters (1984 to 2004).....	3-464
Table 3.11-24	Colorado River, Windy Gap Reservoir to Williams Fork River Confluence, Percent of Total Catch, and Summary Parameters (2001 to 2010) .....	3-466
Table 3.11-25	Colorado River, Williams Fork River to Blue River, Percent of Total Catch and Summary Parameters (1998 to 2010) .....	3-468
Table 3.11-26	Colorado River, Downstream of Windy Gap Reservoir, Macroinvertebrate Population Data Summary Parameters (2007 to 2010) .....	3-471
Table 3.11-27	Blue River: Dillon Reservoir to Green Mountain Reservoir, Fish Population Data, Percent of Total Catch, and Summary Parameters (1976 to 2000).....	3-474
Table 3.11-28	Blue River: Dillon Reservoir to Green Mountain Reservoir, Fish Population Data, Percent of Total Catch, and Summary Parameters (2001 to 2008).....	3-474
Table 3.11-29	Blue River, Downstream of Dillon Reservoir, Macroinvertebrate Population Data Summary Parameters (1985 and 2004 to 2006).....	3-476
Table 3.11-30	Blue River: Green Mountain Reservoir to Colorado River, Fish Population Data, Percent of Total Catch, and Summary Parameters (2001, 2002, 2005, and 2006) .....	3-477
Table 3.11-31	South Boulder Creek: Upstream of Gross Reservoir, Fish Population Data, Percent of Total Catch, and Summary Parameters (1963 to 1991).....	3-480
Table 3.11-32	South Boulder Creek, Benthic Macroinvertebrate Data (1984 and 1985).....	3-480
Table 3.11-33	South Boulder Creek: Downstream of Gross Reservoir, Fish Population Data, Percent of Total Catch, and Summary Parameters (1976 to 1996).....	3-482
Table 3.11-34	North Fork South Platte River, Fish Population Data, Percent of Total Catch, and Summary Parameters (1976 to 2004) .....	3-485

## **TABLE OF CONTENTS**

---

Table 3.11-35	South Platte River: Chatfield Reservoir to Bear Creek, Fish Population Data, Percent of Total Catch, and Summary Parameters (1979 to 2003) .....	3-490
Table 3.11-36	South Platte River: Chatfield Reservoir to Bear Creek, Fish Population Data and Percent of Total Catch by Habitat in Warm and Coldwater Sections (2005) .....	3-491
Table 3.12-1	Transportation Network Improvements .....	3-494
Table 3.13-1	Average Maximum and Minimum Temperatures.....	3-500
Table 3.13-2	Average Total Precipitation and Snowfall .....	3-500
Table 3.13-3	Wind Data .....	3-501
Table 3.13-4	National Ambient Air Quality Standards.....	3-502
Table 3.13-5	National Ambient Air Quality Standard Monitoring Data .....	3-504
Table 3.13-6	Colorado Class I Areas .....	3-504
Table 3.13-7	Average Visibility for 2001-2005 .....	3-505
Table 3.13-8	Mean Visibility Data.....	3-506
Table 3.13-9	NAAQS Non-attainment and Maintenance Areas in the Denver Area.....	3-507
Table 3.13-10	Conformity <i>de Minimis</i> Threshold Levels .....	3-509
Table 3.14-1	CDOT Noise Abatement Criteria – A-Weighted Sound Level-Decibels .....	3-513
Table 3.14-2a	Allowable Noise Levels, Adams County.....	3-514
Table 3.14-2b	Allowable Noise Levels, Boulder County .....	3-514
Table 3.14-2c	Allowable Noise Levels, City and County of Denver .....	3-514
Table 3.14-2d	Allowable Noise Levels, Jefferson County .....	3-515
Table 3.15-1	Existing and Planned Recreation Facilities at Gross Reservoir.....	3-518
Table 3.18-1	Previously Recorded Sites in the Gross Reservoir APE.....	3-557
Table 3.18-2	Newly Recorded Cultural Resources in the Gross Reservoir APE .....	3-557
Table 3.18-3	Previously Recorded Cultural Resources in the Leyden Gulch Site APE.....	3-558
Table 3.18-4	Newly Recorded Cultural Resources in the Leyden Gulch Site APE.....	3-559

---

# **TABLE OF CONTENTS**

---

Table 3.18-5	Previously Recorded Sites within the Conduit M APE.....	3-560
Table 3.18-6	Previously Recorded Sites within the Conduit O APE .....	3-563
Table 3.18-7	Previously Recorded Sites in the South Platte River Facilities APE.....	3-568
Table 3.18-8	Sites Recorded in the Denver Basin Aquifer Storage and Recovery APE .....	3-568
Table 3.19-1	Socioeconomic Primary and Secondary Impact Areas for Each Project Component and Alternative .....	3-572
Table 3.20-1	Hazardous Material Site Database Search Criteria .....	3-595
Table 3.20-2	Hazardous Material Sites Identified within the Gross Reservoir Study Area in 2006 .....	3-597
Table 3.20-3	Hazardous Material Sites Identified Adjacent to and within the Leyden Gulch Reservoir Site in 2006 .....	3-599
Table 3.20-4	Hazardous Material Sites Identified Near the Worthing, South Tower, and Challenger Gravel Pits in 2006 .....	3-600
Table 4.2.2-1	Denver Metropolitan Area Population Statistics .....	4-9
Table 4.3.1-1	Water-based Actions Considered for Cumulative Effects Analysis .....	4-11
Table 4.3.1-2	Summary of Average, Wet, and Dry Year Flows at the South Platte River at Kersey Gage for NISP (Glade Reservoir Plus South Platte Water Conservation Project) .....	4-15
Table 4.3.1-3	Summary of Grand County and Summit County Demands and Shortages for Full Use with a Project Alternative with RFFAs (2032) .....	4-28
Table 4.3.1-4	Historical Gains from Shoshone Call Relaxation March 14 through May 20 Inclusive.....	4-32
Table 4.6.1-1	Water-based Actions Considered for Cumulative Effects Analysis .....	4-53
Table 4.6.1-2	Locations where Hydrologic Data were Analyzed in the Fraser River Basin .....	4-75
Table 4.6.1-3	Summary of Simulated Bypass Flow Reductions .....	4-77
Table 4.6.1-4	Summary of Daily Bypass Flow Reductions Compared to Current Conditions (2006).....	4-78

## **TABLE OF CONTENTS**

---

Table 4.6.1-5	Summary of Grand County and Summit County Demands and Shortages for the Project Alternative Scenarios .....	4-85
Table 4.6.1-6	Summary of Grand County Demands and Shortages with and without Bypass Reductions in the Fraser River Basin.....	4-88
Table 4.6.2-1	Vollenweider Calculations Estimating Relative Change in Phosphorus Concentrations in Gross Reservoir.....	4-182
Table 4.6.2-2	Inflows Into and Outflows From the Three Lakes System for the Three Lakes Water-Quality Model .....	4-188
Table 4.6.2-3	Model Results for the Three Lakes System (Calendar Years 1975 to 1988) .....	4-192
Table 4.6.2-4	Regression Equation Coefficients .....	4-195
Table 4.6.2-5	Predicted Minimum SM-DAM DO Concentrations (0.5 to 2 meters) .....	4-198
Table 4.6.2-6	Temperature at GCWIN Stations in the Fraser River Basin (yearly data recording begins between April and July and ends between September and November) .....	4-202
Table 4.6.2-7	Assumed WWTP Effluent Concentrations for Total Nitrogen and Total Phosphorus, Current Conditions (2006) and 2032 .....	4.219
Table 4.6.2-8	Assumed Monthly WWTP Flow Rates for Current Conditions (2006) and 2032 .....	4-221
Table 4.6.2-9	Land Use by Sub-Basin .....	4-222
Table 4.6.2-10	Export Coefficients Used in the Fraser Nutrient Model .....	4-223
Table 4.6.2-11	Total Average Annual Unattenuated Nutrient Loads to the Fraser River Basin, Current Conditions (2006) .....	4-224
Table 4.6.2-12	Percent Contribution of Each Loading Term to Simulated Total Nitrogen and Total Phosphorus Concentrations at the Mouth of the Fraser River, Current Conditions (2006) .....	4-224
Table 4.6.2-13	Modeled Annual Average Total Nitrogen Concentration Changes in the Fraser River Basin.....	4-229
Table 4.6.2-14	Modeled Annual Average Total Phosphorus Concentration Changes in the Fraser River Basin.....	4-230
Table 4.6.2-15	Calculated Acute and Chronic Low Flow.....	4-231
Table 4.6.2-16	Temperature at GCWIN Stations on the Colorado River .....	4-239
Table 4.6.2-17	Calculated Acute and Chronic Low Flow below Dillon Reservoir .....	4-249
Table 4.6.2-18	Estimated Percent JSA Wastewater Treatment Plant Treated Effluent of Dillon Reservoir Releases .....	4-250

---

# TABLE OF CONTENTS

---

Table 4.6.2-19	Potential Changes in Release Patterns of Dillon Reservoir.....	4-252
Table 4.6.2-20	Calculated Acute and Chronic Low Flow at Wolford Mountain Dam Outlet .....	4-254
Table 4.6.2-21	Changes in Percent Wastewater for Months with Decreases in Flow of 10% or More .....	4-255
Table 4.6.2-22	Summary of 1971 and 1972 Outflow Temperature Differences for Simulated Alternatives.....	4-259
Table 4.6.2-23	South Platte River Downstream of Chatfield, Changes in PACSM Predicted Low Flows .....	4-269
Table 4.6.2-24	Estimated Changes in Percent Wastewater Effluent Caused by Changes in Releases from Chatfield Reservoir (Using 2030 Estimated Wastewater Effluent Discharges) .....	4-270
Table 4.6.3-1	Aerial Photo Comparison .....	4-288
Table 4.6.3-2	Historic Stream Sinuosity Comparison .....	4-289
Table 4.6.3-3	Historic Cross Section Comparison – Fraser River Near Winter Park.....	4-292
Table 4.6.3-4	USGS Stream Gage Locations .....	4-293
Table 4.6.3-5	Flow Rates for Stream Gage Assessment.....	4-294
Table 4.6.3-6	Calculated Changes in Gage Height.....	4-297
Table 4.6.3-7	Sediment Supply Equations.....	4-307
Table 4.6.3-8	Calculated Annual Bedload Transport Capacity .....	4-317
Table 4.6.3-9	Calculated Annual Bedload Transport Capacity as a Percent of Current Conditions .....	4-320
Table 4.6.3-10	Calculated Annual Sediment Supply.....	4-327
Table 4.6.3-11	Calculated Sediment Supply as Percent of Current Conditions (2006) .....	4-327
Table 4.6.3-12	Phase 2 Sediment Transport Calculations – Fraser River Basin .....	4-332
Table 4.6.3-13	Phase 2 Sediment Transport Calculations – Williams Fork River Basin .....	4-335
Table 4.6.3-14	Phase 2 Sediment Transport Calculations – Colorado River Basin .....	4-336
Table 4.6.3-15	Phase 2 Sediment Transport Calculations – Blue River Basin.....	4-339
Table 4.6.3-16	Phase 2 Sediment Transport Calculations – North Fork South Platte River Basin .....	4-340
Table 4.6.3-17	Phase 2 Sediment Transport Calculations – South Boulder Creek Basin .....	4-342

## **TABLE OF CONTENTS**

---

Table 4.6.3-18	Five- and 10-Year Peak Flow Calculations – Fraser River Basin .....	4-344
Table 4.6.3-19	Five- and 10-Year Peak Flow Calculations – Williams Fork River Basin.....	4-346
Table 4.6.3-20	Five- and 10-Year Peak Flow Calculations – Colorado River Basin .....	4-347
Table 4.6.3-21	Five- and 10-Year Peak Flow Calculations – Blue River Basin.....	4-348
Table 4.6.3-22	Five- and 10-Year Peak Flow Calculations – North Fork South Platte River Basin .....	4-349
Table 4.6.3-23	Five- and 10-Year Peak Flow Calculations – South Boulder Creek Basin.....	4-350
Table 4.6.3-24	Effective Discharge – Fraser River Basin.....	4-352
Table 4.6.3-25	Effective Discharge – Williams Fork River Basin .....	4-355
Table 4.6.3-26	Effective Discharge – Colorado River Basin.....	4-356
Table 4.6.3-27	Effective Discharge – Blue River Basin .....	4-358
Table 4.6.3-28	Effective Discharge – North Fork South Platte River Basin .....	4-359
Table 4.6.3-29	Effective Discharge – South Boulder Creek Basin.....	4-360
Table 4.6.8-1	Probability Plot Flow Events .....	4-423
Table 4.6.8-2	Two-Year Flow Changes for Sampling Sites, Total Environmental Effects with the Proposed Action with RFFAs (2032) Compared to Current Conditions (2006).....	4-427
Table 4.6.8-3	Five-Year Flow Changes for Sampling Sites, Total Environmental Effects with the Proposed Action with RFFAs (2032) Compared to Current Conditions (2006).....	4-428
Table 4.6.8-4	Ten-Year Flow Changes for Sampling Sites, Total Environmental Effects with the Proposed Action with RFFAs (2032) Compared to Current Conditions (2006).....	4-429
Table 4.6.8-5	Width of Overbank Flooding, Total Environmental Effects with the Proposed Action with RFFAs (2032) Compared to Current Conditions (2006) .....	4-431
Table 4.6.8-6	Summary of Hydrological Changes for Fraser River Tributaries from Total Environmental Effects with the Proposed Action with RFFAs (2032), Compared to Current Conditions (2006) .....	4-435
Table 4.6.8-7	Summary of Hydrological Changes for Williams Fork Tributaries, Total Environmental Effects with the Proposed Action with RFFAs (2032) Compared to Current Conditions (2006) .....	4-440

## **TABLE OF CONTENTS**

---

Table 4.6.8-8	Two-, Five-, and 10-Year Flow Changes for Sampling Sites, Total Environmental Effects with Alternative 1c with RFFAs (2032) Compared to Current Conditions (2006) .....	4-450
Table 4.6.8-9	Two-, Five-, and 10-Year Flow Changes for Sampling Sites, Total Environmental Effects with Alternatives 8a and 10a with RFFAs (2032) Compared to Current Conditions (2006).....	4-451
Table 4.6.8-10	Two-, Five-, and 10-Year Flow Changes for Sampling Sites, Total Environmental Effects with Alternative 13a with RFFAs (2032) Compared to Current Conditions (2006) .....	4-452
Table 4.6.8-11	Two-, Five-, and 10-Year Flow Changes for Sampling Sites, Total Environmental Effects with No Action Alternative with RFFAs (2032) Compared to Current Conditions (2006).....	4-453
Table 4.6.11-1	Stream Segments Modeled with PHABSIM in the Moffat Project Area .....	4-474
Table 4.6.11-2	Periodicity of Fish Species in Streams in the Moffat Project Area .....	4-475
Table 4.6.11-3	PHABSIM Habitat Relationships Available for Stream Segments, Trout Species, and Life Stages in the Moffat Collection System Project Area.....	4-477
Table 4.6.11-4	Aquatic Biological Resources Cumulative Impacts and Intensity Descriptions for the Moffat Project with RFFAs .....	4-479
Table 4.6.15-1	Fraser River below Crooked Creek, Current Conditions (2006) Versus Proposed Action with RFFAs (2032), Number of Days at a Given Flow Rate for Kayaking .....	4-542
Table 4.6.15-2	Colorado River below Kremmling, Current Conditions (2006) Versus Proposed Action with RFFAs (2032), Number of Days at a Given Flow Rate for Rafting and Kayaking .....	4-545
Table 4.6.15-3	Blue River Near Boulder Creek, Current Conditions (2006) Versus Proposed Action with RFFAs (2032), Number of Days at a Given Flow Rate for Boating .....	4-546
Table 4.6.15-4	Blue River below Green Mountain Reservoir, Current Conditions (2006) Versus Full Use with Proposed Action with RFFAs (2032), Number of Days at a Given Flow Rate for Boating .....	4-547
Table 4.6.15-5	Fraser River below Crooked Creek, Current Conditions (2006) Versus the No Action Alternative with RFFAs (2032), Number of Days at a Given Flow Rate for Kayaking .....	4-552

## **TABLE OF CONTENTS**

---

Table 4.6.15-6	Colorado River below Kremmling, Current Conditions (2006) Versus the No Action Alternative with RFFAs (2032), Number of Days at a Given Flow Rate for Boating.....	4-554
Table 4.6.15-7	Blue River Near Boulder Creek, Current Conditions (2006) Versus the No Action Alternative with RFFAs (2032), Number of Days at a Given Flow Rate for Boating.....	4-554
Table 4.6.19-1	Summary of Total Socioeconomic Impacts for the Proposed Action with RFFAs (2032) .....	4-588
Table 4.6.19-2	Summary of Total Socioeconomic Impacts for Alternative 1c with RFFAs (2032) .....	4-590
Table 4.6.19-3	Summary of Total Socioeconomic Impacts for Alternative 8a with RFFAs (2032) .....	4-591
Table 4.6.19-4	Summary of Total Socioeconomic Impacts for Alternative 10a with RFFAs (2032) .....	4-592
Table 4.6.19-5	Summary of Total Socioeconomic Impacts for Alternative 13a with RFFAs (2032) .....	4-594
Table 4.6.19-6	Summary of Total Socioeconomic Impacts for the No Action Alternative with RFFAs (2032) .....	4-598
Table 5.2-1	Modeled Concentrations in the Three Lakes (Modeled Hydrologic Years of 1975 to 1989) .....	5-102
Table 5.2-2	Total Nitrogen Concentrations in the Fraser River Basin.....	5-105
Table 5.2-3	Total Phosphorus Concentrations in the Fraser River Basin .....	5-106
Table 5.2-4	Estimated Percent Wastewater in the Blue River, Downstream of Dillon Reservoir .....	5-122
Table 5.2-5	Estimated Influences of Tributaries to the Blue River.....	5-123
Table 5.3-1	Calculated Annual Bedload Transport Capacity.....	5-128
Table 5.3-2	Calculated Annual Bedload Transport Capacity as a Percent of Full Use of the Existing System .....	5-131
Table 5.3-3	Calculated Annual Sediment Supply .....	5-137
Table 5.3-4	Calculated Sediment Supply as Percent of Full Use of the Existing System .....	5-138
Table 5.3-5	Phase 2 Sediment Transport Calculations – Fraser River Basin.....	5-142
Table 5.3-6	Phase 2 Sediment Transport Calculations – Williams Fork River Basin.....	5-144

# TABLE OF CONTENTS

---

Table 5.3-7	Phase 2 Sediment Transport Calculations – Colorado River Basin .....	5-145
Table 5.3-8	Phase 2 Sediment Transport Calculations – Blue River Basin.....	5-147
Table 5.3-9	Phase 2 Sediment Transport Calculations – North Fork South Platte River Basin .....	5-148
Table 5.3-10	Phase 2 Sediment Transport Calculations – South Boulder Creek Basin .....	5-149
Table 5.3-11	Five- and 10-Year Peak Flow Calculations – Fraser River Basin .....	5-151
Table 5.3-12	Five- and 10-Year Peak Flow Calculations – Williams Fork River Basin .....	5-153
Table 5.3-13	Five- and 10-Year Peak Flow Calculations – Colorado River Basin .....	5-154
Table 5.3-14	Five- and 10-Year Peak Flow Calculations – Blue River Basin .....	5-154
Table 5.3-15	Five- and 10-Year Peak Flow Calculations – North Fork South Platte River Basin .....	5-155
Table 5.3-16	Five- and 10-Year Peak Flow Calculations – South Boulder Creek Basin .....	5-156
Table 5.3-17	Effective Discharge – Fraser River Basin .....	5-157
Table 5.3-18	Effective Discharge – Williams Fork River Basin .....	5-160
Table 5.3-19	Effective Discharge – Colorado River Basin .....	5-161
Table 5.3-20	Effective Discharge – Blue River Basin.....	5-162
Table 5.3-21	Effective Discharge – North Fork South Platte River Basin .....	5-162
Table 5.3-22	Effective Discharge – South Boulder Creek Basin .....	5-163
Table 5.7-1	Proposed Action (Alternative 1a) Vegetation Impacts at Gross Reservoir.....	5-220
Table 5.7-2	Impacts to Sensitive Plant Communities at Gross Reservoir .....	5-223
Table 5.7-3	Alternative 1c Vegetation Impacts at Gross Reservoir .....	5-224
Table 5.7-4	Alternative 1c Vegetation Impacts at the Leyden Gulch Reservoir Site .....	5-225
Table 5.7-5	Alternatives 8a and 10a Vegetation Impacts at Gross Reservoir .....	5-227
Table 5.7-6	Alternative 8a Vegetation Impacts at South Platte River Facilities .....	5-228
Table 5.7-7	Alternative 13a Vegetation Impacts at Gross Reservoir .....	5-231

## **TABLE OF CONTENTS**

---

Table 5.7-8	Alternative 13a Vegetation Impacts at South Platte River Facilities .....	5-231
Table 5.8-1	Summary of Direct Impacts to Wetlands.....	5-236
Table 5.8-2	Summary of Impacts to Other Waters of the U.S. ....	5-238
Table 5.8-3	Summary of Impacts to Riparian Habitats .....	5-240
Table 5.8-4	Two-Year Flow Changes for Sampling Sites, Proposed Action Compared to Full Use of the Existing System.....	5-244
Table 5.8-5	Five-Year Flow Changes for Sampling Sites, Proposed Action Compared to Full Use of the Existing System.....	5-245
Table 5.8-6	Ten-Year Flow Changes for Sampling Sites, Proposed Action Compared to Full Use of the Existing System.....	5-245
Table 5.8-7	Width of Overbank Flooding, Proposed Action Compared to Full Use of the Existing System .....	5-248
Table 5.8-8	Summary of Hydrological Changes for Fraser River Tributaries, Proposed Action with RFFAs Compared to Full Use of the Existing System .....	5-254
Table 5.8-9	Summary of Hydrological Changes for Williams Fork Tributaries, Proposed Action with RFFAs Compared to Full Use of the Existing System .....	5-257
Table 5.8-10	Two-, Five-, and 10-Year Flow Changes for Sampling Sites, Alternative 1c Compared to Full Use of the Existing System .....	5-267
Table 5.8-11	Two-, Five-, and 10-Year Flow Changes for Sampling Sites, Alternative 8a Compared to Full Use of the Existing System .....	5-270
Table 5.8-12	Two-, Five-, and 10-Year Flow Changes for Sampling Sites, Alternative 13a Compared to Full Use of the Existing System .....	5-275
Table 5.8-13	Two-Year Flow Changes for Sampling Sites, No Action Alternative Compared to Full Use of the Existing System.....	5-276
Table 5.8-14	Five- and 10-Year Flow Changes for Sampling Sites, No Action Alternative Compared to Full Use of the Existing System.....	5-277
Table 5.9-1	Direct Impacts to Wildlife Habitat in Gross Reservoir Study Area by Alternative .....	5-282
Table 5.9-2	Direct Impacts to Elk Seasonal Habitats.....	5-283
Table 5.9-3	Impacts to USFS Wildlife Habitats.....	5-287
Table 5.9-4	Direct Impacts to Sensitive Areas by Alternative.....	5-290

# TABLE OF CONTENTS

---

Table 5.9-5	Direct Impacts to Wildlife Habitat at the Leyden Gulch Reservoir Site Under Alternative 1c.....	5-294
Table 5.10-1	Impacts to Special Status Plant Species at Gross Reservoir.....	5-313
Table 5.11-1	Stream Segments Modeled with PHABSIM in the Moffat Project Area .....	5-338
Table 5.11-2	Periodicity of Fish Species in Streams in the Moffat Project Area .....	5-339
Table 5.11-3	PHABSIM Habitat Relationships Available for Stream Segments, Trout Species, and Life Stages in the Moffat Collection System Project Area.....	5-341
Table 5.11-4	Aquatic Biological Resources Impacts and Intensity Descriptions for the Moffat Project Area .....	5-343
Table 5.12-1	Peak Vehicle Trips by Alternative .....	5-394
Table 5.13-1	Construction Emissions for the Proposed Action – Gross Reservoir.....	5-408
Table 5.13-2	Construction Emissions for Alternative 1c – Gross Reservoir.....	5-409
Table 5.13-3	Construction Emissions for Alternative 1c – Leyden Gulch Reservoir Site .....	5-410
Table 5.13-4	Construction Emissions for Alternative 8a – Gross Reservoir.....	5-411
Table 5.13-5	Construction Emissions for Alternative 8a – South Platte River Facilities .....	5-412
Table 5.13-6	Construction Emissions for Alternative 10a – Denver Basin Aquifer Facilities .....	5-413
Table 5.13-7	Construction Emissions for Alternative 13a – Gross Reservoir.....	5-414
Table 5.13-8	Construction Emissions for Alternative 13a – South Platte River Facilities.....	5-415
Table 5.13-9	Possible Control Measures to Minimize Fugitive Dust.....	5-416
Table 5.14-1	Noise Standards and Guidelines .....	5-419
Table 5.15-1	Fraser River below Crooked Creek, Full Use of the Existing System vs. the Proposed Action (2032), Number of Days at a Given Flow Rate for Rafting and Kayaking.....	5-437

## **TABLE OF CONTENTS**

---

Table 5.15-2	Colorado River below Kremmling, Full Use of the Existing System vs. the Proposed Action (2032), Number of Days at a Given Flow Rate for Rafting and Kayaking .....	5-439
Table 5.15-3	Blue River Near Boulder Creek, Full Use of the Existing System vs. the Proposed Action (2032), Number of Days at a Given Flow Rate for Boating .....	5-440
Table 5.18-1	Summary of Impacts to Significant Sites from Leyden Gulch Reservoir .....	5-480
Table 5.18-2	Summary of Impacts to Significant Sites from Conduit O .....	5-483
Table 5.18-3	Summary of Impacts to Significant Sites from Denver Basin Aquifer Facilities .....	5-484
Table 5.18-4	Summary of Impacts to Significant Sites from Conduit M .....	5-485
Table 5.19-1	Changes to Demographic Conditions from the Proposed Action .....	5-501
Table 5.19-2	Changes to Housing Conditions from the Proposed Action .....	5-503
Table 5.19-3	Summary of the Impacts of the Proposed Action on Public Facilities and Services.....	5-507
Table 5.19-4	Summary of Socioeconomic Impacts of the Proposed Action .....	5-513
Table 5.19-5	Changes to Demographic Conditions from Alternative 1c.....	5-519
Table 5.19-6	Changes to Housing Conditions from Alternative 1c .....	5-520
Table 5.19-7	Summary of the Impacts of Alternative 1c on Public Facilities and Services .....	5-522
Table 5.19-8	Summary of Socioeconomic Impacts of Alternative 1c .....	5-526
Table 5.19-9	Changes to Demographic Conditions from Alternative 8a.....	5-532
Table 5.19-10	Changes to Housing Conditions from Alternative 8a .....	5-533
Table 5.19-11	Summary of the Impacts of Alternative 8a on Public Facilities and Services .....	5-535
Table 5.19-12	Summary of Socioeconomic Impacts of Alternative 8a .....	5-539
Table 5.19-13	Changes to Demographic Conditions from Alternative 10a.....	5-545
Table 5.19-14	Changes to Housing Conditions from Alternative 10a .....	5-546
Table 5.19-15	Summary of the Impacts of Alternative 10a on Public Facilities and Services .....	5-548
Table 5.19-16	Summary of Socioeconomic Impacts of Alternative 10a .....	5-552
Table 5.19-17	Potential Irrigated Acreage Losses Under Alternative 13a.....	5-557

# **TABLE OF CONTENTS**

---

Table 5.19-18	Percentage Loss in Weld County Irrigated Acreage Under Alternative 13a .....	5-557
Table 5.19-19	Changes to Demographic Conditions from Alternative 13a .....	5-559
Table 5.19-20	Changes to Housing Conditions from Alternative 13a.....	5-561
Table 5.19-21	Summary of the Impacts of Alternative 13a on Public Facilities and Services.....	5-562
Table 5.19-22	Summary of Socioeconomic Impacts of Alternative 13a.....	5-566
Table 5.19-23	Summary of Socioeconomic Impacts of the No Action Alternative .....	5-577
Table 5.19-24	Comparison of Socioeconomic Impacts of the Proposed Action and Alternatives 1c, 8a, 10a, and 13a .....	5-577
Table 5.20-1	Potential for Environmental Release from Hazardous Material Sites Identified Adjacent to and within the Leyden Gulch Reservoir Site .....	5-580
Table 5.20-2	Potential for Environmental Release from Hazardous Material Sites Identified Adjacent to and within the Worthing and South Tower Gravel Pits .....	5-581
Table 5.20-3	Hazardous Material Sites Identified Near Challenger Gravel Pit Storage Area .....	5-583
Table 5.20-4	Possible Mitigation for the Leyden Gulch Reservoir Site.....	5-585
Table 5.20-5	Possible Mitigation Near the Worthing and South Tower Pits .....	5-585
Table 5.20-6	Possible Mitigation Near the Challenger Pit .....	5-586
Table 5.22-1	Summary of Impacts by Alternative.....	5-591
Table 5.22-2	Summary of Impacts to River Segments .....	5-563
Table 6-1	List of Agencies and Organizations Contacted for the EIS .....	6-8
Table 6-2	List of EIS Preparers .....	6-10
Table 6-3a	List of Agencies, Organizations, and Persons to Whom Hard Copies of the Moffat Final EIS were Sent.....	6-13
Table 6-3b	List of Agencies, Organizations, and Persons to Whom Electronic Copies of the Moffat Final EIS were Sent .....	6-14

# TABLE OF CONTENTS

---

## List of Figures

Figure ES-1	Public and Agency Participation Key Dates .....	ES-1
Figure ES-2	Denver Water's Collection System.....	ES-4
Figure ES-3	Total Annual Denver Water System Demand Versus Supply .....	ES-6
Figure ES-4	Rivers Evaluated for the Moffat Project .....	ES-17
Figure 1-1	Denver Water's Collection System.....	1-3
Figure 1-2	Collection System Components .....	1-9
Figure 1-3	Collection System Imbalance .....	1-11
Figure 1-4	Combined Service Area, Fixed Contracts, and Major Distribution Facilities .....	1-13
Figure 1-5	Total Annual Denver Water System Demand Versus Supply .....	1-16
Figure 2-1	Overview of Alternative Components .....	2-27
Figure 2-2	Proposed Action (Alternative 1a) Components .....	2-37
Figure 2-3	Gross Reservoir Components .....	2-41
Figure 2-4	Gross Dam Plan and Profile.....	2-43
Figure 2-5	Potential Aggregate Haul Routes.....	2-49
Figure 2-6	Alternative 1c – Components.....	2-61
Figure 2-7	Alternative 1c – Proposed Leyden Gulch Reservoir.....	2-67
Figure 2-8	Proposed Leyden Gulch Reservoir – Embankment Section .....	2-69
Figure 2-9	Alternative 8a – Components.....	2-75
Figure 2-10	Alternative 8a – Typical Gravel Pit Storage Facilities .....	2-81
Figure 2-11	Typical Slurry Wall Lined Gravel Pit.....	2-82
Figure 2-12	Typical River Diversion Structure .....	2-83
Figure 2-13	Typical Pump Station Layout .....	2-85
Figure 2-14	Denver Water Dechlorination Facility.....	2-86
Figure 2-15	Alternative 10a – Components.....	2-91
Figure 2-16	Typical Well Layout for Proposed Deep Aquifer Storage and Recovery System .....	2-94
Figure 2-17	Typical Well House for Proposed Deep Aquifer Storage and Recovery System .....	2-95
Figure 2-18	Alternative 13a – Components.....	2-101

# **TABLE OF CONTENTS**

---

Figure 2-19	Alternative 13a – Typical Gravel Pit Storage Facilities .....	2-107
Figure 2-20	Typical Outlet Structure .....	2-108
Figure 2-21	Typical Stream Crossing .....	2-115
Figure 3.0-1	River Segments Overall Study Area.....	3-9
Figure 3.0-2	Study Area River Segments – West Slope .....	3-11
Figure 3.0-3	Study Area River Segments – East Slope.....	3-13
Figure 3.0-4	Study Area River Segments – Platte River Basin .....	3-15
Figure 3.0-5	Minimum Instream Flow Rights – Fraser River Basin .....	3-17
Figure 3.0-6	Minimum Instream Flow Rights – Williams Fork River Basin .....	3-19
Figure 3.1-1	Fraser River at Winter Park Gage Average Daily Streamflow .....	3-35
Figure 3.1-2	Colorado River Average Annual Flow at Hot Sulphur Springs, 1904-1994.....	3-46
Figure 3.1-3	Colorado River at Hot Sulphur Springs Gage Average Daily Flows .....	3-46
Figure 3.4-1	Fraser River Watershed Areas.....	3-176
Figure 3.4-2	Groundwater Data in Fraser River Valley.....	3-179
Figure 3.4-3	Groundwater and Topographic Elevations .....	3-180
Figure 3.4-4	Water Levels, Jim Creek Area.....	3-183
Figure 3.4-5	Hydrologic Cross-Section A-A', Jim Creek.....	3-184
Figure 3.4-6	Water Levels, Winter Park Area .....	3-187
Figure 3.4-7	Hydrographs of Winter Park Wells .....	3-188
Figure 3.4-8	Hydrologic Cross-Section B-B', Winter Park Area .....	3-189
Figure 3.4-9	Water Levels, Lower Fraser River Area.....	3-191
Figure 3.4-10	Hydrologic Cross-Section C-C', Lower Fraser River .....	3-192
Figure 3.4-11	Water Levels, St. Louis Creek Area .....	3-195
Figure 3.4-12	Hydrologic Cross-Section A-A', St. Louis Creek .....	3-196
Figure 3.4-13	Hydrologic Cross-Section B-B', St. Louis Creek .....	3-197
Figure 3.4-14	Hydrographs of the Jim Creek Area .....	3-202
Figure 3.4-15	Hydrographs of the Fraser River Area .....	3-203
Figure 3.4-16	Hydrographs of the St. Louis Creek Area .....	3-204
Figure 3.4-17	Water Levels, Jim Creek Area.....	3-209

---

## **TABLE OF CONTENTS**

---

Figure 3.4-18	Water Levels, Lower Fraser River Area .....	3-211
Figure 3.4-19	Water Levels, St. Louis Creek Area .....	3-213
Figure 3.4-20	Williams Fork Watershed Areas .....	3-214
Figure 3.5-1	Geology – Alternatives Components .....	3-219
Figure 3.7-1	Vegetation – Gross Reservoir .....	3-235
Figure 3.7-2	Vegetation – Leyden Gulch Site .....	3-237
Figure 3.8-1	Wetlands – Gross Reservoir.....	3-257
Figure 3.8-2	Wetlands – Leyden Gulch Site .....	3-259
Figure 3.8-3	Wetlands – Conduits M and O.....	3-261
Figure 3.8-4	Wetlands – South Platte River Facilities .....	3-263
Figure 3.8-5	Wetlands – Denver Basin Aquifer Facilities .....	3-265
Figure 3.9-1	Wildlife – Mule Deer Habitat .....	3-325
Figure 3.9-2	Wildlife – American Elk Habitat .....	3-329
Figure 3.9-3	Wildlife – Sensitive Areas and Wildlife Corridors.....	3-337
Figure 3.9-4	Wildlife – Prairie Dogs and Raptor Nests.....	3-339
Figure 3.9-5	Wildlife – River Otter Habitat .....	3-341
Figure 3.10-1	Special Status Species – Bald Eagle Habitat .....	3-369
Figure 3.10-2	Special Status Species – Preble’s Meadow Jumping Mouse Habitat.....	3-373
Figure 3.11-1	Habitat Availability (in Weighted Useable Area in Square Feet per 1,000 Feet of Stream) for the Modeled Life Stages of Rainbow and Brown Trout in Segments 3 and 4 of the Fraser River.....	3-416
Figure 3.11-2	Trout Density at the Kemp-Breeze SWA Site on the Colorado River, 1983-2010 .....	3-469
Figure 3.11-3	Trout Biomass at the Kemp-Breeze SWA Site on the Colorado River, 1983-2010 .....	3-469
Figure 3.11-4	Habitat Availability (in Weighted Useable Area in Square Feet per 1,000 Feet of Stream) for Various Life Stages of Brown Trout in Segments 1 and 2 of the North Fork South Platte River.....	3-484

# TABLE OF CONTENTS

---

Figure 3.12-1	Transportation – Roads in the Project Area .....	3-497
Figure 3.13-1	Visibility Trends in Denver and the Front Range (1990 through 2005).....	3-507
Figure 3.15-1	Recreation – Gross Reservoir .....	3-521
Figure 3.16-1	Land Ownership – Gross Reservoir .....	3-535
Figure 3.16-2	Land Ownership – Leyden Gulch Site .....	5-539
Figure 3.19-1	Gross Reservoir and Leyden Gulch Site – Primary Socioeconomic Impact Areas (PIAs) .....	3-574
Figure 3.19-2	South Platte River Facilities and Water Rights Acquisition Area – Primary Socioeconomic Impact Areas (PIAs).....	3-579
Figure 3.19-3	Advanced Water Treatment Plant (AWTP) – Primary Socioeconomic Impact Areas (PIAs) .....	3-583
Figure 4.6.1-1	Comparison of Williams Fork Reservoir Contents During the Critical Period.....	4-63
Figure 4.6.1-2	Comparison of Dillon Reservoir Contents During the Critical Period.....	4-65
Figure 4.6.1-3	Comparison of Wolford Mountain Reservoir Contents During the Critical Period.....	4-67
Figure 4.6.1-4	Comparison of Gross Reservoir Contents During the Critical Period.....	4-69
Figure 4.6.1-5	Comparison of Antero Reservoir Contents During the Critical Period.....	4-70
Figure 4.6.1-6	Comparison of Eleven Mile Canyon Reservoir Contents During the Critical Period.....	4-72
Figure 4.6.1-7	Comparison of Cheesman Reservoir Contents During the Critical Period.....	4-73
Figure 4.6.2-1	Chlorophyll <i>a</i> Concentrations Observed in Gross Reservoir, Peak Annual Concentration Dates Noted .....	4-179
Figure 4.6.2-2	Total Phosphorus Observations from 2005 through 2011 (From the Moffat Tunnel and From South Boulder Creek Near the Moffat Tunnel) .....	4-181
Figure 4.6.2-3	Simulated Profiles for 1971 with 2012 Meteorology, Near Gross Reservoir Dam .....	4-184

## **TABLE OF CONTENTS**

---

Figure 4.6.2-4	Simulated Gross Reservoir Water Temperature at 3-Foot Depth Near Dam, 1971 and 1972, 2012 Meteorology.....	4-185
Figure 4.6.2-5	Three Lakes Water-Quality Model Schematic .....	4-189
Figure 4.6.2-6	Average Dissolved Oxygen Concentrations in Shadow Mountain Reservoir at Site SM-DAM (0.5 to 2 meters depth).....	4-194
Figure 4.6.2-7	Observed and Predicted Dissolved Oxygen at SM-DAM (0.5 to 2 meters average).....	4-196
Figure 4.6.2-8	Correlation between Observed and Predicted SM-DAM Dissolved Oxygen (0.5 to 2 meters average) .....	4-196
Figure 4.6.2-9	Predicted SM-DAM DO Concentrations (0.5 to 2 meters average).....	4-197
Figure 4.6.2-10	Flow Versus Water Temperature in the Fraser River Basin Section 303(d) Listed Stream Segments .....	4-204
Figure 4.6.2-11	Air Temperature Versus Water Temperature for Section 303(d) Listed Stream Segments in the Fraser River Basin.....	4-205
Figure 4.6.2-12	Typical Water Temperature, Air Temperature, and Flow Over Time .....	4-205
Figure 4.6.2-13	Mean Daily Flow Rate Versus Water Temperature for Fraser River Near Winter Park (No Exceedance of State Water Temperature Standard at this Site).....	4-209
Figure 4.6.2-14	Daily Mean Flow Rate Versus Water Temperature for the Fraser River below Crooked Creek (No Exceedance of State Water Temperature Standard at this Site).....	4-212
Figure 4.6.2-15	Mean Daily Flow Rate Versus Water Temperature for Ranch Creek below CR 8315 .....	4-215
Figure 4.6.2-16	Total Nitrogen Calibration for Fraser River Nutrient Model.....	4-226
Figure 4.6.2-17	Total Phosphorus Calibration for Fraser River Nutrient Model .....	4-227
Figure 4.6.2-18	Monthly Simulated Total Nitrogen Concentrations at the Mouth of the Fraser River, Current Conditions (2006) and the Proposed Action with RFFAs (2032) .....	4-228
Figure 4.6.2-19	Monthly Simulated Total Phosphorus Concentrations at the Mouth of the Fraser River, Current Conditions (2006) and the Proposed Action with RFFAs (2032) .....	4-228
Figure 4.6.2-20	Relationship Between Flow and Water Temperature for Colorado River below Windy Gap .....	4-241
Figure 4.6.2-21	Relationship Between Air Temperature and Water Temperature for the Colorado River below Windy Gap .....	4-242

# TABLE OF CONTENTS

---

Figure 4.6.2-22	Typical Water Temperature, Air Temperature, and Flow Over Time.....	4-242
Figure 4.6.2-23	Mean Daily Flow Rate Versus Water Temperatures for the Colorado River below Windy Gap (No Exceedance of State Acute Water Temperature Standard at this Site) .....	4-244
Figure 4.6.2-24	Simulated Outflow Temperatures from Gross Reservoir for Base285 and Alternative 1a, 1971 and 1972, 2009 Meteorological Inputs.....	4-258
Figure 4.6.2-25	Observed Temperature Difference between Gross Reservoir Outlet and South Boulder Creek at Ralston Diversion.....	4-260
Figure 4.6.3-1	Historic Cross Section Comparison – Fraser River Near Winter Park.....	4-291
Figure 4.6.3-2	Comparison of Sediment Supply Equations.....	4-308
Figure 4.6.3-3	Effective Discharge Schematic.....	4-316
Figure 4.6.11-1	WUA for Adult and Spawning Brook Trout in Segment 1 of the Fraser River for a Median Year Under Current Conditions (2006) and the Proposed Action with RFFAs (2032).....	4-484
Figure 4.6.11-2	WUA for Three Life Stages of Rainbow Trout in Segment 1 of the Fraser River for a Median Year Under Current Conditions (2006) and the Proposed Action with RFFAs (2032).....	4-485
Figure 4.6.11-3	WUA for Adult and Spawning Brook Trout in Segment 2 of the Fraser River for a Median Year Under Current Conditions (2006) and the Proposed Action with RFFAs (2032).....	4-487
Figure 4.6.11-4	WUA for Three Life Stages of Brown Trout in Segment 3 of the Fraser River for a Median Year Under Current Conditions (2006) and the Proposed Action with RFFAs (2032).....	4-489
Figure 4.6.11-5	WUA for Three Life Stages of Rainbow Trout in Segment 5 of the Fraser River for a Median Year Under Current Conditions (2006) and the Proposed Action with RFFAs (2032).....	4-492
Figure 4.6.11-6	WUA for Spawning and Adult Brook Trout in Vasquez Creek in a Median Year Under Current Conditions (2006) and the Proposed Action with RFFAs (2032) .....	4-498
Figure 4.6.11-7	WUA for Spawning and Adult Brook Trout in Ranch Creek for a Median Year Under Current Conditions (2006) and the Proposed Action with RFFAs (2032) .....	4-502

## **TABLE OF CONTENTS**

---

Figure 4.6.11-8	WUA for Three Life Stages of Brown Trout in Segment 1 of the Colorado River (CPW-Lone Buck Site) for a Median Year Under Current Conditions (2006) and the Proposed Action with RFFAs (2032) .....	4-508
Figure 4.6.11-9	WUA for Two Life Stages of Rainbow Trout in Segment 1 of the Colorado River (Miller-Lone Buck Site) for a Median Year Under Current Conditions (2006) and the Proposed Action with RFFAs (2032) .....	4-509
Figure 4.6.11-10	WUA for Three Life Stages of Rainbow Trout in Segment 3 of South Boulder Creek for a Median Year Under Current Conditions (2006) and the Proposed Action with RFFAs (2032) .....	4-516
Figure 4.6.11-11	WUA for Four Life Stages of Brown Trout in Segment 2 of the North Fork South Platte River for a Median Year Under Current Conditions (2006) and the Proposed Action with RFFAs (2032) .....	4-519
Figure 5.8-1	Sampling Site Fraser River 1 (FR1) – Riparian Vegetation Effects .....	5-247
Figure 5.8-2	Sampling Site Fraser River 3 (FR3) – Riparian Vegetation Effects .....	5-252
Figure 5.11-1	WUA for Adult and Spawning Brook Trout in Segment 1 of the Fraser River for a Median Year Under Full Use of the Existing System and the Proposed Action (2032) .....	5-348
Figure 5.11-2	WUA for Three Life Stages of Rainbow Trout in Segment 1 of the Fraser River for a Median Year Under Full Use of the Existing System and the Proposed Action (2032) .....	5-349
Figure 5.11-3	WUA for Adult and Spawning Brook Trout in Segment 2 of the Fraser River for a Median Year Under Full Use of the Existing System and the Proposed Action (2032) .....	5-351
Figure 5.11-4	WUA for Three Life Stages of Brown Trout in Segment 3 of the Fraser River for a Median Year Under Full Use of the Existing System and the Proposed Action (2032) .....	5-352
Figure 5.11-5	WUA for Three Life Stages of Rainbow Trout in Segment 5 of the Fraser River for a Median Year Under Full Use of the Existing System and the Proposed Action (2032) .....	5-355
Figure 5.11-6	WUA for Spawning and Adult Brook Trout in Vasquez Creek for a Median Year Under Full Use of the Existing System and the Proposed Action (2032) .....	5-361

# TABLE OF CONTENTS

---

Figure 5.11-7	WUA for Spawning and Adult Brook Trout in Ranch Creek for a Median Year Under Full Use of the Existing System and the Proposed Action (2032).....	5-364
Figure 5.11-8	WUA for Three Life Stages of Brown Trout at the Lone Buck Site in Segment 1 of the Colorado River for a Median Year Under Full Use of the Existing System and the Proposed Action (2032).....	5-370
Figure 5.11-9	WUA for Two Life Stages of Rainbow Trout at the Lone Buck Site in Segment 1 of the Colorado River for a Median Year Under Full Use of the Existing System and the Proposed Action (2032).....	5-371
Figure 5.11-10	WUA for Four Life Stages of Brown Trout in Segment 2 of the Blue River for a Median Year Under Full Use of the Existing System and the Proposed Action (2032) .....	5-375
Figure 5.11-11	WUA for Three Life Stages of Rainbow Trout in Segment 3 of South Boulder Creek for a Median Year Under Full Use of the Existing System and the Proposed Action (2032) .....	5-378
Figure 5.11-12	WUA for Four Life Stages of Brown Trout in Segment 2 of the North Fork South Platte River for a Median Year Under Full Use of the Existing System and the Proposed Action (2032) .....	5-381
Figure 5.15-1	Conceptual Recreation Relocation Plan – Dam Area, Gross Reservoir .....	5-431
Figure 5.15-2	Conceptual Recreation Relocation Plan – Haul Road and Peninsula Areas, Gross Reservoir .....	5-433
Figure 5.15-3	Conceptual Recreation Relocation Plan – South Boulder Creek Inlet Area, Gross Reservoir .....	5-435
Figure 5.17-1	Photographic Simulation of the Proposed Action at Gross Reservoir.....	5-462
Figure 5.17-2	Photographic Simulation of the Proposed Leyden Gulch Reservoir.....	4-471
Figure 5.19-1	Annual Employment Generated from Construction Activities in the Proposed Action .....	5-489
Figure 5.19-2	Annual Income Generated from Construction Activities in the Proposed Action .....	5-490
Figure 5.19-3	Annual Economic Output Generated from Construction Activities in the Proposed Action for the Four-Year Construction Period .....	5-492

## **TABLE OF CONTENTS**

---

Figure 5.19-4	Annual Employment Generated from Construction Activities in Alternative 1c.....	5-515
Figure 5.19-5	Annual Income Generated from Construction Activities in Alternative 1c.....	5-516
Figure 5.19-6	Annual Economic Output Generated from Construction Activities in Alternative 1c .....	5-517
Figure 5.19-7	Annual Employment Generated from Construction Activities in Alternative 8a.....	5-528
Figure 5.19-8	Annual Income Generated from Construction Activities in Alternative 8a.....	5-529
Figure 5.19-9	Annual Economic Output Generated from Construction Activities in Alternative 8a .....	5-530
Figure 5.19-10	Annual Employment Generated from Construction Activities in Alternative 10a.....	5-541
Figure 5.19-11	Annual Income Generated from Construction Activities in Alternative 10a.....	5-542
Figure 5.19-12	Annual Economic Output Generated from Construction Activities in Alternative 10a .....	5-543
Figure 5.19-13	Annual Employment Generated from Construction Activities in Alternative 13a.....	5-554
Figure 5.19-14	Annual Income Generated from Construction Activities in Alternative 13a.....	5-555
Figure 5.19-15	Annual Economic Output Generated from Construction Activities in Alternative 13a .....	5-556

# **TABLE OF CONTENTS**

---

## **List of Appendices**

### **Volume 5 of 10**

- Appendix A      Purpose and Need Support
- Appendix B      Alternatives Screening Information
- Appendix C      AWT Process Diagrams and Site Plans
- Appendix D      Construction Information
- Appendix E      Surface Water Resources
- Appendix F      Soils within the Project Area

### **Volume 6 of 10**

- Appendix G      Biological Resources

### **Volume 7 of 10**

- Appendix H      Hydrologic Data and PACSM Output (H-1 through H-6)

### **Volume 8 of 10**

- Appendix H      Hydrologic Data and PACSM Output (H-7 through H-22)

### **Volume 9 of 10**

- Appendix I      Air Quality Data
- Appendix J      Public Notices
- Appendix K      Preliminary Section 404(b)(1) Guidelines Analysis
- Appendix L      Draft Programmatic Agreement

### **Volume 10 of 10**

- Appendix M      Conceptual Mitigation
- Appendix N      Comments Received on the Draft EIS and Responses